metal finishing

APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING
ANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 4 No. 46 (New Series) OCTOBER, 1958

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metal finishing Journal

October, 1958 Vol. 4, No. 46 (New Series)

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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AMING THE DOG

THERE is available today to the manufacturer of almost any product a range of finishes so bewildering in its variety that effective selection of the finish, appropriate to a given application, is a task of substantial proportions. Indeed, the considerations and variables involved are often so complex that it is reasonable to suppose that proper exploration of all possibilities and application of all relevant criteria is very rare indeed.

In view of the complexity of the situation the choice of a finishing system or material for a particular purpose is often decided by factors which would not normally be considered as being of major significance. In this connexion tradition and conservatism play an important part and a considerable degree of sales resistance to a new process or product is not uncommonly met with solely on the grounds of its novelty. Furthermore novelty in this context can often mean introduction within anything up to the past thirty years. Indeed, it is only a slight exaggeration to say that in certain fields of application the use for example of aluminium is still regarded as a novel and somewhat daring experiment.

While it would be foolish to deny a real value to an informed reluctance to being bulldozed into experimenting with every novelty that the finishing industry throws up, there is on the other hand a very real responsibility implicit in the very great, perhaps some would say disproportionately great, influence that adequacy of finish has on sales.

As we said earlier, the criteria which have to be considered in selecting a finishing system are many and varied, and include such fundamental and comparatively easily determinable factors as cost in relation both to materials and method of application, durability in service, particularly in specialized environments, ease of maintenance or reprocessing, and availability of an adequate colour range. To these must be added the more ephemeral but none the less highly significant consideration of current trends in popular taste and fashion.

Although these points have been made chiefly in relation to manufactured products, they apply with no less relevancy to other instances where the selection of a finishing process is involved, as for example, in the building industry. It was therefore, presumably with some appreciation of the need for overcoming some of these resistances to progress that the Aluminium Development Association staged recently, largely for the benefit of architects and contractors, an Exhibition and Lecture Symposium on "Colour-Anodized Aluminium for Exterior Use."

There is no doubt that the possibilities of using colour to a much greater extent on the exterior of buildings are attracting an increasing amount of attention, and a measure of competition has developed between such interested industries as vitreous enamelling, anodized aluminium, and plastics, with even stainless steel and bronze sheet occasionally coming into the picture.

It is however, during these early development stages that prejudices and preformed opinions are most likely to be established. One unfortunate experience by an architect or a building contractor may colour his judgment for a long time. When a process is well established and widely adopted, inferior workmanship is recognized for what it is, but until such a steady state has been reached, faults are apt to be attributed to shortcomings in the material or the process itself and the dog, thus illnamed, suffers an untimely demise.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

TALL STORY

STORIES, as is well known, tend to grow in the telling, and those who assiduously read the technical press may have been disconcerted by the way in which a recent American statement on the increasing use of aluminium in the automobile industry has developed. Starting with a statement issued by the Kaiser Aluminium Corporation to the effect that the average 1958 American car contains 39.6 lb. of aluminium (13 per cent. more than in the previous year) one British plating journal appears to have jumped to the conclusion that most of the metal was being used for chemically brightened and anodized parts in replacement of chromium plate. In point of fact, while the use of the metal for this application has been increasing to some extent, the main bulk of the aluminium is going into structural members which have nothing to do with bright trim. Anyhow, the summarized view was that "indeed, all that glitters on the modern American car (with the exception of the bumper) is likely to be aluminium."

This was bad enough, but the climax came last month in yet another periodical which went the whole hog and decided, presumably after digesting the earlier reports, that on the average 1958 American car "with the exception of the bumper bar, the nickel-chromium finish for all bright parts has been replaced by aluminium". Quite apart from the evidence which is there for all to see in and around Berkeley Square, and the fact that no-one has yet succeeded in devising a process for making the numerous die-cast parts (including handles) of bright aluminium, anyone giving the matter a little thought would realise at once that this incredible statement could have no basis in fact. For the American automobile industry to replace the whole of its vast chromium plate requirements by bright aluminium would be a change of such magnitude that it simply could not be accomplished in years, even if everything were in its favour. One is not surprised to see careless reporting in the more ephemeral popular press, but to find it in serious technical journals is a new and disturbing phenomenon.

TOO MUCH TITANIUM

WITH the falling off in aircraft requirements, production of titanium is now only about a quarter of what was expected when I.C.I. put in their multi-million pound production facilities at Wilton, Birmingham and South Wales. This is apart from some two million pounds spent on research. A concerted effort is, however, being made to increase the use of the metal in chemical engineering applications, where its high corrosion resistance is outstanding. With the strength of steel, and only half its weight, titanium is excellent for heating and cooling coils for chromium plating solutions of the sulphate type, and when made anodic it will withstand other acids, particularly sulphuric acid. Other interesting applications are the use of platinum-plated titanium as anodes in chromium plating instead of lead, and for cathodic corrosion prevention systems. The price is, however, still high (around £5 per lb.) which is a factor limiting its expansion, but some economy can be effected by using it in the form of thin linings. It would not be at all surprising if titanium did not become quite a common-place metal in plating plant in a few years.

CITY FATHERS DO RESEARCH

BIRMINGHAM has always been noted for the wide range of its municipal activities. Long before the age of nationalization, the city started its gas, electricity, water and transport undertakings and it even runs a municipal bank. Less well-known perhaps is the fact that it has its own Industrial Research Laboratories run by the Public Works Department. This is a unique enterprise in this country, and possibly in the world. Apart from working for the Corporation (which provides about a quarter of its income) it offers its services to any company or organization at home or abroad which is willing to pay for them. Some sixty per cent of its income comes from private firms, of which two-thirds are actually outside the city; its consulting, advisory and testing services cover a wide range, but are principally used by the chemical and mechanical engineering, metallurgical and building industries.

With a staff of 40 and a budget of some £40,000 per annum, it is especially interesting to see that it operates at a profit.

WELL PUT

"IT is in the nature of things for early descriptions of any new process to be optimistic. It is also rational for later progress reports to be more accurate, but less frequent."

From a letter in "Chemistry and Industry"

Automatic POLISHING, WASHING and PLATING of HUB CAPS

at the Basildon Works of the FORD MOTOR Co. Ltd.

A NEW plant has been installed by the Ford Motor Co. Ltd. at their Basildon Works for the automatic polishing, pressure washing and automatic bright copper, nickel and chrome plating of motor-car hub caps.

The automatic polishing machines and automatic plating plant have been designed and supplied by W. Canning and Co. Ltd. and Immerspray washing plant by Edward Curran Engineering Ltd.

The plating plant is designed to process 240 hub caps per hour under the control of one operator who not only loads and unloads the plant but is also responsible for loading the jigs with unplated work, inspecting the finished processed work and packing it for despatch.

Hub caps are of two designs and are polished on the three automatic rotary-table polishing machines. The larger machine is equipped with ten chuck spindles which during polishing carry the hub caps past eight polishing heads arranged around the table. These heads are of 6- and 5-H.P. size and polish all visible surfaces of the hub caps, composition being applied to the mops by automatic applicators (Figs 1 and 2)

The polished hub caps are loaded into the iron cradles of the washing machine and are then carried on a mono-rail through the spray-washing plant. This takes them through a special hot alkaline cleaning solution, " Immerspray Compound B ".

The cradle is withdrawn from the immersion section and passes through the pressure rinse, the rinse water being maintained at a temperature

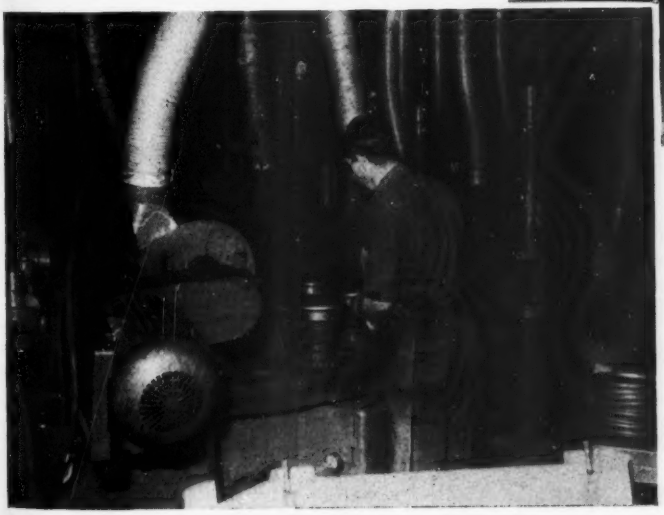


Fig. 1.—(left) General view of one of the Canning automatic rotary-table polishing machines.

Fig. 2.—(above) Close-up of some of the polishing heads on the rotary-table polishing machine.

of 160° to 180°F. and sprayed on to the hub caps at a pressure of 12 to 15 lb. per sq. in. (Fig 3). The cradle is then brought by the chain conveyor to the loading end of the plating plant and the hub caps are removed from the cradle and immediately loaded on to the plating jigs (Fig 4) ready to be loaded on to the plating plant.

The automatic plating plant is an electro-hydraulic two-line return-type unit. Each work-arm carries two jigs, each jig holding four hub caps. The general arrangement of plating sequence is shown in Fig. 5. The overall size of plant is 61ft. 6in. long x 14ft. wide x 12ft. 6in. high.

Cleaning is carried out in the first two process tanks (Fig 6) the solution is Anodax used electro-lytically in both tanks. The first tank is heated and handles two workarms at a time so processing sixteen hub caps at once. The second cleaning tank is used cold and handles one workarm.

The third stage is a cold swill, followed by a hydrochloric-acid dip. Then follows a cold swill and a cyanide dip. The hub caps then pass to the cyanide copper process. This tank handles three work arms at a time so processing 24 hub caps.

Cyanide-copper plating is followed by a cold-water swill, a sulphuric-acid dip and a further cold-water swill. The load then reaches the Sulfast copper plating tank which will handle eleven workarms with 88 hub caps. On removal from the tank, each jig is sprayed with high-pressure clean water to remove carried over copper solution. The hub cap is then bright nickel plated in a Super Gleamax Solution. The nickel tank holds twenty workarms—160 hub caps (Fig 7) and is followed by two cold swills after which the work passes into the Zonax bright chromium solution. This tank holds four workarms—32 hub caps. From the chrome tank (Fig. 8) the work is passed through the drag-out tank, cold-water swill, hot-water swill and then arrives at the unloading station.

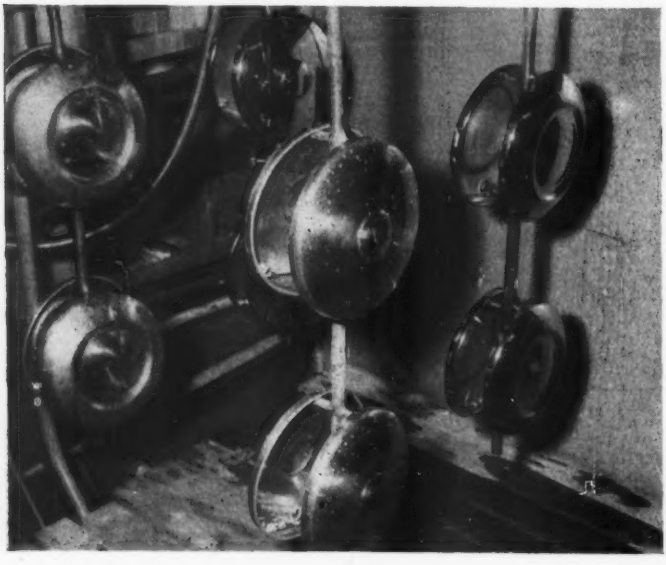


Fig. 3.—(above) View of interior of Curran "Immerspray" washing plant.

Fig. 4.—(left) Loading end of plating plant showing, in the foreground, hub discs jigged ready for plating and, in the background, plated discs ready for unloading.

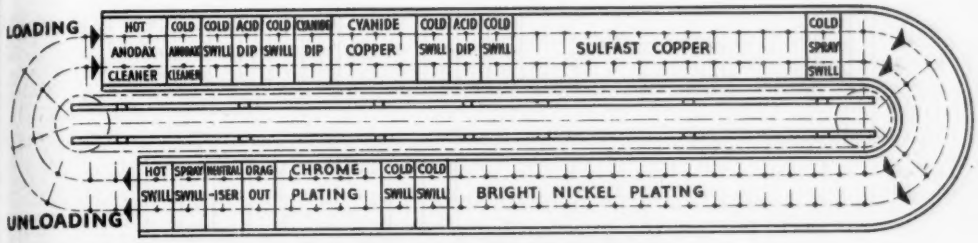


Fig. 5.—(above) Diagram of layout of plating plant.

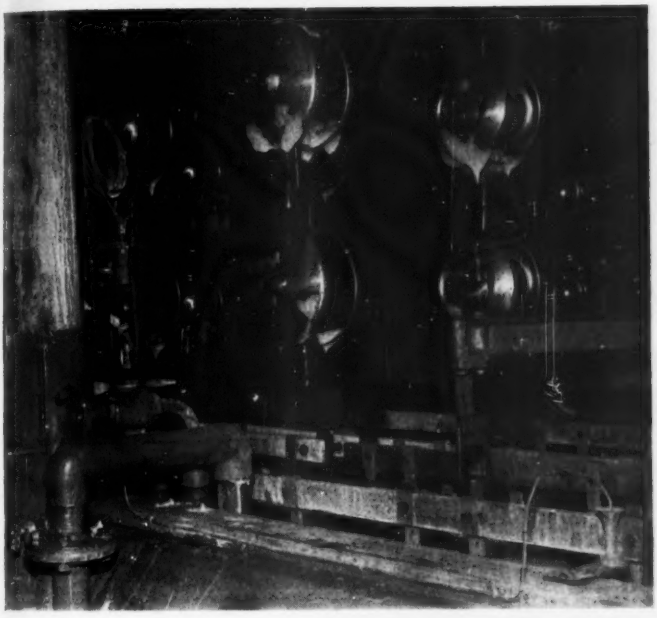


Fig. 6.—(left) Hub discs in the cleaning section of the plant.

Fig. 7.—(below) General view of part of nickel-plating section of the plant.

As part of Ford Motor Company's policy of rigid control of quality, a proportion of the plated caps are checked for thickness of deposit.

Thickness is inspected by micro measurement and typical results at the positions shown in Fig. 9 on each type of hub cap are shown in Table I.

Test hub caps are also subjected to a minimum of 100 hours salt-spray test.

The cyanide copper solution is continuously pressure filtered through a Prefect filter (Fig. 10).

In addition to the passage of the workarms through the plant, they are agitated in a vertical

Fig. 8.—(right) Hub-discs leaving the chromium vats.

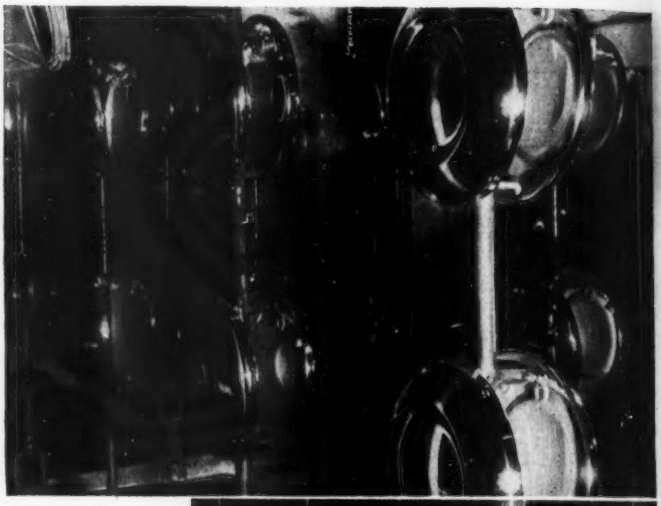


Fig. 9.—(below) Diagram of sections of two types of hub cap showing positions at which thickness measurements are taken (see also Table I).

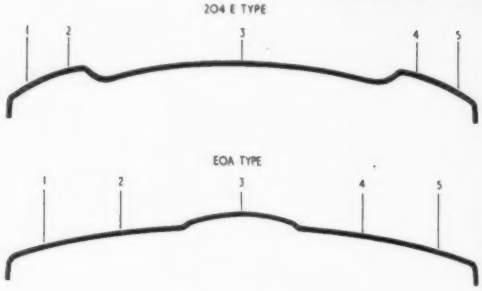


Fig. 10.—(below, right) One of the filter installations.

TABLE I.

204E. Type		EOA. Type	
Copper	Nickel	Copper	Nickel
1. 0.00105	0.00175	0.0007	0.0012
2. 0.0008	0.0013	0.0005	0.0008
3. 0.0007	0.0009	0.0006	0.0011
4. 0.0006	0.0011	0.0005	0.0008
5. 0.0007	0.0012	0.0006	0.0012

The thickness of chromium is 0.00001 in.

movement by a special cam device on the plant.

The Sulfast copper anodes are suspended in a diaphragm anode compartment (Fig. 11) and the bottom of each diaphragm is connected to the intake of the pump which passes the solution through the Prefect filter. Filtered solution is then returned to the cathode section of the vat thus ensuring that anode debris is trapped and does not enter the plating compartment. Hub caps leaving the Sulfast bright copper are shown in Fig. 12.

Steam and fume extraction ductwork are fabricated from glass fibre and plastic. Extraction fans are sited above the plant (Fig. 13).

All-cold water swills are connected together and passed to a Permutit water reclamation plant, in which the water is treated and returned to the plating plant for further use.

There are a number of other interesting features of this plant. For example circulating pump and special jets give turbulence and circulation to the Anodax cleaner and each swill is equipped with a spray wash which saturates the hub caps and jigs in clean water as they leave the swills.

A comprehensive control panel is fitted with a full range of meters and indicating lights for all processes together with starter buttons for the rectifiers, hydraulic drive motors for the fans, pumps etc. Temperature-recording charts are provided and the process vats are fitted with thermostats and motorized valves for steam supplies.

All the filters are fitted with a warning device to shew when they need cleaning.

Carbon-block heat exchangers utilizing steam at 60 lb. per sq. in. are provided for heating the

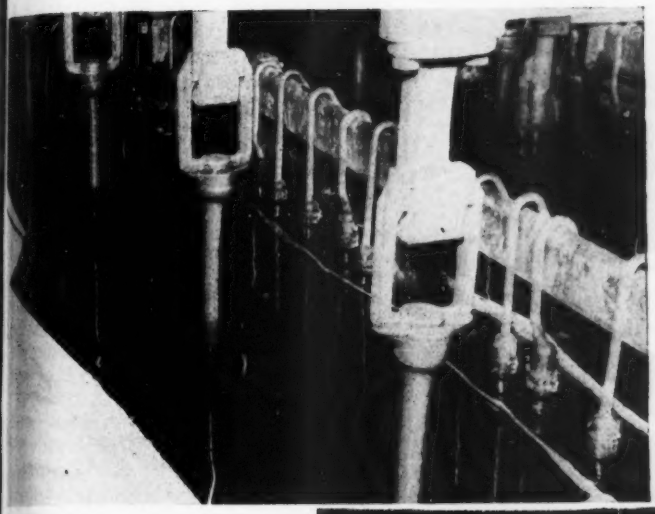


Fig. 11.—(above) View of copper plating (Sulfast) section showing diaphragm anode compartment.

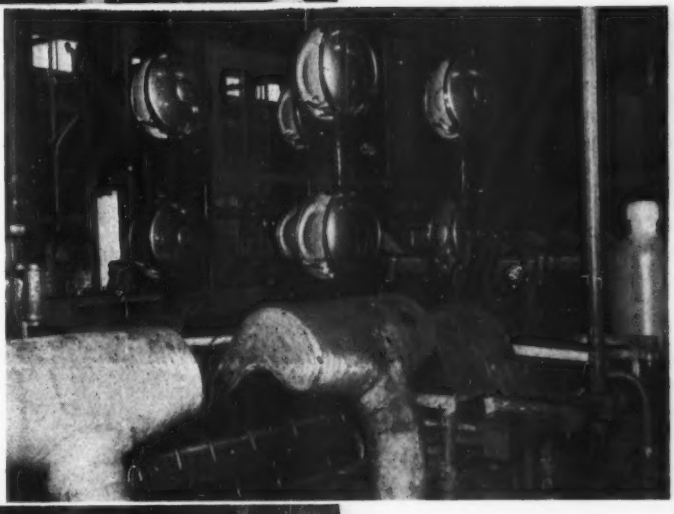


Fig. 12.—(right) Hub discs after bright copper plating.

Fig. 13.—(below) Extraction equipment.

nickel and copper vats, and 4,000 gallons of Super Gleamax bright nickel solution are raised from cold to working temperature in 2 hours.

To facilitate maintenance the traverse and the lifting motion can be moved independently and to simplify restarting, contactors and relays have been wired so that by pressing one button the entire plant automatically puts itself into sequence.

Canning-Westalite rectifiers totalling 20,000 amp. provide capacity to deal with any forseeable demand arising from design change and are protected with overload current relays which give visible and audible warning.

Instead of the usual extraction using factory " conditioned " air from all sides of the plant a " push-pull " system has been installed which reduces heat losses.

Seven totally-enclosed Prefect filters, (two of which are shown in Fig. 10) are provided to handle the two cyanide and acid-copper and nickel solutions. The filters are lined throughout with rubber and are fitted with a

(*Continued in page* 388)

Some Comments on THE THEORY AND USE OF SOLVENT DRIERS

THE use of solvents as heat-transfer media for rapid drying dates back over 30 years, an early application being the combined drying out and removal of resins from damp wood with trichlorethylene vapour. In drying metal, however, the problem remained of staining due to soluble contaminants in the final swill. It is only in the last few years that this has been overcome in a simple, rapid and economical way, by the A.S.L. stain-free drying process.

The principle of this process is the use of a highly stable wetting agent in the solvent which rapidly displaces the water from the metal surface leaving the latter temporarily coated with an almost mono-molecular film of this strongly polar agent. The wetting agent is subsequently largely rinsed away in pure solvent. Displaced water, still retaining its soluble impurities, mixes with the solvent to form an azeotropic mixture—which boils at a lower temperature than either constituent.

The chlorinated hydrocarbons are the most valuable commercial solvents for this purpose, in view of their relatively high stability, low toxicity and desirable physical attributes : trichlorethylene and perchlorethylene are the principal ones, the former being about 9 per cent cheaper and having the lower b.p., 87°C. compared with 120°C, for perchlorethylene.

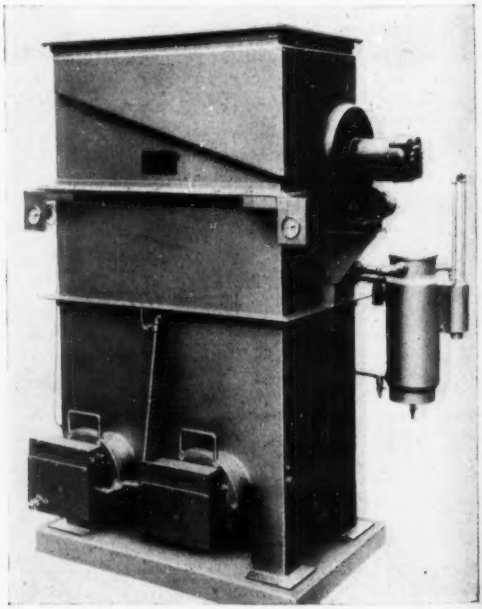
The azeotropic mixture of water and trichlorethylene boils at 73°C. and the first impression is that the lower price and b.p. of this solvent would make it the more economically attractive of the two. This is patently misleading though since the azeotropic mixture in this case comprises 14 parts of solvent to 1 part of water. The perchlorethylene mixture *per contra* contains only 2 parts of solvent for each one of water, and boils at 87.5°C. The net result is that driers using

Fig. 1.—A medium-sized A.S.L. metal dryer plant with a drying capacity ranging from 100 to 300 kilograms per hour of metal parts according to the heating equipment installed.

(Courtesy Roto-Finish Ltd).

Fig. 2.—Close-up of the A.S.L. dryer. It closely resembles a vapour-degreasing plant outwardly, but the continuous water-separator can be seen, on the left-hand side, while there is also a fan to remove any vapour which may in exceptional cases rise above the condensing coils.

(Courtesy of Meccano Ltd., and Roto-Finish Ltd).



perchlorethylene require only about a third of the heat input of those using trichlorethylene; moreover, the drying action is more rapid with the former.

Solvent drying alone, however, whether with vapour or boiling solvent, is neither stain-free nor sufficiently speedy. Some way of displacing the water both from the main faces and from interstices is needed, so that the azeotropic mixture forms and evaporates well away from the metal and soluble impurities do not crystallize on its surface. Early attempts indicated that the use of a solvent-water emulsion would achieve this, and a mixture of 2 per cent emulsifier (wetting agent) and 2 per cent water in solvent was evolved Boiling, this would take

(*Continued in page* 388)

Fig. 3.—View of the compartment containing the A.S.L. additive. The initially very vigorous action when wet work is introduced is now subsiding : the dense blanket of vapour evolved when the action is at its height makes it impossible to photograph it.

(Courtesy of Meccano Ltd., and Roto-Finish Ltd).

Table I

Drying with Per. and ASL. compared with Tri. and ASL, in a Wacker Metal Dryer, type TS/ASL 4-4/5

		" PER "				" TRI "		
Stages of Operation.	Time, sec.	Radiation at 1.2 kg. cal/sec.	Per (litres) at 0.0235 l/sec.	Water vaporized (litres)	Time, sec.	Radiation at 0.6 kg.-cal/sec.	Tri (litres) at 0.0306 l/sec	Water vaporized (litres)
Placing work in Compartment 1	15	18	0.35	—	15	9.0	0.456	—
Compartment 1 Warming up work	35	42	—	—	7	4.2	—	—
Vaporization.	15	18	0.425	0.06	43	25.8	1.510	0.02
Transfer of work to Comp. 2	10	12	—	—	10	6.0	—	—
Compartment 2 Warming up work.	10	12	—	—	1	0.6	—	—
Vaporization.	5	6	0.12	—	14	8.4	0.430	—
Removing work from Comp. 2	5	6	0.12	—	5	3.0	0.150	—
Drying off work over Comp. 2.	15	18	0.35	—	15	9	0.450	—
Final removal of work from Dryer.	10	12	0.235	—	10	6.0	0.306	—
Totals	120	144	1.6	0.06	120	72	3.302	0.02
Analysis : Work per hour 30 x 6 = 180 kg.					30 x 2 = 60 kg.			
Radiation losses 4.3 m². x 1000 = 4300 kg.-cal.					4.3m². x 500 = 2150 kg.-cal.			
Evaporation of water 1.8 kg. x 630 = 1140 kg.-cal.					0.6 kg. x 630 = 380 kg.-cal.			
Evaporation of solvent 481 x 87 = 4175 kg.-cal.					991 x 87 = 8610 kg.-cal.			
Heating work (steel) 180 kg. x 11.1 = 2000 kg.-cal.					60 kg. x 8 = 480 kg.-cal.			
Hourly heat requirements 11615 kg.-cal.					11620 kg.-cal.			
Heat applied 13.5 kw = 11660 kg.-cal./hr.					11660 kg.-cal./hr.			

It can be seen from the above data that to evaporate 1 litre of water, 43 kg. of ' Per ' or 240 kg. of ' Tri ' is required. On this basis, ' Per ' is 5 - 6 times as effctive as ' Tri ' as a drying medium. Using the same plant, to dry 100 kg. of work requires only 7.5 kW-hr. with ' Per ' as compared with 22.5 kW-hr. with ' Tri '.

New Production Line For Vitreous - Enamelling Quality Titanium Oxide

FOR what is claimed to be the first time outside the United States of America, a full production line is being devoted to the manufacture of a grade of titanium oxide especially for the vitreous-enamelling industry. Laporte Titanium Ltd. have converted their Luton factory to the production of this grade, known as Tiona V, which will be marketed in the form of fine granules which are free flowing, thus ensuring easy handling and easy mixing with the other constituents of the frit without balling. It is claimed that the fine ultimate particle size of the granules ensures their rapid solution in the frit during smelting, thus avoiding the insoluble sediments which are often formed and which necessitate costly cleaning-out operations.

The greater packed bulk density of this grade also reduces storage space and facilitates handling, and a high degree of standardization of colour tone and reflectance are also claimed.

Tiona V is available in three different qualities and thus enamel manufacturers are given a choice of colour tone and reflectance.

The production of Tiona V is sufficient to satisfy the demand from vitreous enamel manufacturers and samples and production quantities are now available.

Solvent Driers

(*Continued from page* 387)

up as much as 60 per cent of its weight in water, the boiling points being 74°C. and 90°C. for tri. and per. respectively. The plant was designed along similar lines to a vapour degreaser, and incorporated a means for continuously separating excess water from the emulsion, and a final rinse stage in pure solvent.

The first of these driers were marketed early in 1936, particularly in Switzerland, but although superficially successful the drying process was neither consistently nor completely stain-free. This was attributed to variations in the nature and amount of emulsifier. Later attempts to obtain a stable solvent-water emulsion included the use of ultrasonic agitation but it is only about 4 years since absolute success has been achieved, this using the A.S.L. emulsifier.

The A.S.L. process*, developed by the German company Wacker Chemie, uses perchlorethylene together with a minute amount, 0.01 per cent, of an extremely stable and powerful organic surface active agent, the A.S.L. additive. This additive is quickly absorbed onto the metal surfaces and displaces every trace of water in seconds, this being boiled off almost as rapidly as the azeotropic mixture forms. Perchlorethylene is chosen both for its lower heating cost requirements and also (its boiling point of 119.5°C, being appreciably higher than that of trichlorethylene,) because it provides a greater reservoir of heat and, in consequence, more rapid drying. Damp work when immersed in the boiling solvent containing the A.S.L. compound causes a very vigorous ebullition, and the water is completely displaced and evaporated in a minute or two while dissolved salts sink into the sump. A brief rinse in pure solvent completes the drying operation.

Attempts at developing a dryer based on trichlorethylene although from the above exposition and the attached table apparently abortive, are still being pursued. To achieve comparable performance, though, apart from the higher heating costs, such a plant would need to be about 3 times the size of a perchlorethylene dryer. (*see* Table I)

*Sole U.K. suppliers Roto-Finish, Ltd.

References

(1) Winters, J. B., and Hull R. O., *Proc. Am. Electroplaters' Soc.*, 1949, p. 93.
(2) Lorch, W. F., *Laboratory Practice*, 1958, January.

Ford Motor Co. Ltd.—Basildon Plating Plant

(*Continued from page* 385)

swing lid for very easy cleaning. A slurry tank enables the filters to be loaded with carbon without dismantling.

Adequate storage vats are provided to hold the plating solutions and all pipework for the filtration equipment is rubber lined.

The entire plant is housed in a separate department which has a floor installed by Acalor Ltd. Space has been left to transfer another Canning automatic plating plant from Dagenham Works to Basildon thus centralizing all the equipment for plating motor-car hub caps.

THE INSTITUTE OF METAL FINISHING

1958 ANNUAL CONFERENCE IN TORQUAY

Report of Technical Sessions

(*Concluded from page* 316, *August*, 1958

Abstract No. 10

The Physics and Physiology of Colour Vision

by R. W. G. Hunt

THE scientific study of colour can be said to have started with the famous experiment conducted by Sir Isaac Newton in the year 1666, when he showed that the white light from the sun consisted of a mixture of all the colours of the spectrum. It is by absorbing and reflecting to different extents the different colours of the spectrum that everyday objects present their characteristic colours. In fact, in one sense, colours can be accurately measured and specified in terms of the percentage of light they reflect and absorb at each wavelength throughout the spectrum. Curiously enough, however, to specify colour in this way can be misleading, inasmuch as too much information is given. For two colours may have very different spectral reflection curves and yet appear to the eye to be identical. It is not possible, therefore, to understand the phenomena of colour without considering the parts played by the eye as well as those played by the illuminant and the objects concerned. Thomas Young in 1801 first suggested that the way in which the eye analysed colour was by breaking it down into three fundamental sensations of redness, greenness, and blueness. He put forward the idea that in the eye there are basically three perceptions, one sensitive to green, another to red and another to blue light.

The response of the eye depends on the amount to which each of these three receptors is stimulated by the given colour. This is the so-called trichromatic theory of colour vision, and it is quite revolutionary, because it states that the brain is able to perceive colour from three basic primary stimuli by various combinations of these three stimuli, red, green and blue.

The eye consists of a transparent sheath, the cornea. There is the iris which limits the amount of light which hits the eye in order not to blind it with the light and in order to open out and allow in more light when the light is dim. The next important part is the eye lens which helps to focus objects on the retina, a clear semi-fluid sphere which allows the light to pass through, and finally the retina. Most of the retina is of not very high sensitivity and not very high resolving power.

When it is necessary to see things sharply, *i.e.*, to focus on a little patch, this is done by turning the eye or turning the head. Very few people realize that most vision is in this small region. The rest is peripheral vision and helps to make things look real.

In the eye there are a large number of nerve cells, endings and connexions through which the light passes first, before it gets on to the really light-sensitive parts, which consist of two types of units, *viz.*, rods and cones. These units become smaller as the centre of the fovea is approached and bigger and wider near the edges, which explains why it is possible to see more sharply in one place than in another. In addition, there is a black pigment which absorbs any stray light and prevents what in photography is called halation. Present knowledge is that the cones are responsible for colour vision ; the rods are responsible for vision under very dark illumination.

From this basic conception the theory and science of colour vision, colour specification and colour measurement have been built up, and also the theory and practice of colour reproduction. In fact, there is today an internationally accepted method of specifying colour, known as the C.I.E. system, which is being used more and more, as accurate control of colour is required in science, industry and art. In spite, however, of the considerable knowledge that has been gained over the years there are still many visual effects which remain to be explained. Colour vision is a field in which research is still being undertaken in many parts of the world, and as knowledge of the fundamentals increases, so the ability to make technical progress in the application of colour also advances.

Discussion

MR. J. N. T. ADCOCK (Imperial Chemical Industries Ltd., Paints Division) said that when he used to work in a paint laboratory, he had an assistant who, eventually he discovered was colour-blind. Mr. Adcock had never been quite sure

*Kodak Ltd.

of the mechanism of colour-blindness. His assistant's blindness was the straightforward red/green, and perhaps Mr. Pollak might indicate why this man saw red when he really should have been looking at green, or green when he should have been looking at red.

MR. J. F. KAYSER (Gillette Industries Ltd.) said that he was glad that the Institute had taken up the question of colour. A great deal was known about colour but only in a very restricted circle, and every effort should be made to extend that circle.

He was very interested in colour blindness and not only in regard to human beings but particularly in horses, because he was interested in show jumping. Was the horse colour-blind or not? He thought a horse could distinguish colours. He had done a great deal of experimental work with many different horses, and he did not think it was possible to settle the question by reference to whether it had cones or rods in its eyes.

MR. F. POLLAK, replying to the discussion, said that as far as colour-blindness was concerned, a person's sensitivity to light could be represented by three curves, but they were not the three C.I.E. curves. They differed slightly for every observer. But the international curves were a good average for all normal people, because each person had receptors of slightly different sensitivity.

If a person was red-green colour-blind, his red one was not as it should be. It was probably shifted and his green curve was very near to the red so that the red-green sensitivity curves were very close together.

He did not know about the horse, but he believed that steers were colour blind, and if a red cloth was waved in front of a bull it might just as well be a green one. He was excited only by the movement of a piece of cloth.

Abstract No. 11

Colour and Styling

*by C. G. Neale**

COLOUR is a fundemental element of design and as such is important to the car stylist for three reasons—it is the first attribute of the car to be seen ; it can be used to accentuate or modify form ; it can be used to flatter proportions or suggest modelling on an otherwise plain surface.

A great virtue of colour as an attribute of car design is its flexibility as contrasted with the design of the sheet-metal components.

The task of choosing colour and making first proposals requires particular talents and the constitution of the selection team at the author's works, after some experiment, is now basically an experienced designer working with a young woman well versed in fashion trends. Initial studies are conducted on selected paint chips on large white wall boards. These are followed up with painted door panels mounted out of doors at normal car height against a background of white boards. The colour range for the interior trim is then selected to suit.

Close contact is maintained between sales departments and the stylist so that trends in consumer demand can be watched and preferences charted.

*Briggs Motor Bodies Ltd., Dagenham, Essex.

Abstract No. 12.

The Measurement of Colour

by J. M. Adams†

COLOUR is commonly specified by reference to a standard sample, which method is usually satisfactory in the hands of properly trained craftesman. The possibility of variations of colour in the standard sample and other difficulties create a need for methods of numerical specification of a colour from instrument readings, some of which are described in this paper.

Two commonly used methods are spectrophotometry and colorimetry. Both involve reflectance measurements but give different information. The spectrophotometer measures the reflectance from the test surface at a number of single wave-lengths throughout the visible spectrum and the values of reflectance against wavelength are plotted. Two surfaces having the same spectrophotometric curve will match under any lighting. A photoelectric colorimeter measure reflectance through three primary colour filters and gives readings for red, green and blue reflectances. Reproducibility of results depends on the quality of the light used as a illuminant, the colours of the filters and the sensitivity of the eye or photo cell making the measurement.

The paper continues to discuss examples of these types of instrument and some aspects of their use.

Abstract No. 13

The Selection of Coloured Pigments For Industrial Finishes

by I. S. Moll, B.Sc.‡

THIS paper reviews some of the factor sinfluencing the choice of a coloured pigment and the main properties of a pigment which

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‡Dyestuffs Division, Imperial Chemical Industries Ltd., Manchester

determines its usefulness, particularly in the light of recent trends evaluation.

Colour fastness is largely determined by chemical composition, oxides and hydroxides of iron and chromium and lead, sulphides of cadmium and mercury, prussian blue, and lead chromate, being typical examples of inorganic compunds used. Certain other types of pigment, although essentially organic in composition contain some inorganic material, either as metal salt, metal co-ordination complex, complex metal acid, or absorbing substrate Others are wholly organic.

A wide diversity of shades is available but other essential requirments in respect to properties considerably limits the choice. The properties which have to be considered include, in addition to colour, ease of dispersion in normal media, specific gravity, absorption of medium and flow properties, storage properties, insolubility in solvents, fastness to heat, acids alkalis, fats and light and freedom from the presence of soluble lead.

Discussion

MR. R. J. BROWN (The Austin Motor Co., Ltd.) said that his opinion of the motor car was that the general public took the mechanical aspects of the vehicle for granted. Motor cars were therefore sold on colour and styling, although he would prefer to put it in the reverse order—styling first and colour second. The two factors went hand in hand and there was no doubt that an attractive style could be ruined by an unsatisfactory colour. Conversely, an unsatisfactory style could be made to look acceptable by a judicious choice of colour.

Some of the people interested in electrodeposition had really had a "go" during the Conference. There was a paper by one of those people who create shapes which it was not possible to press, on which it was not possible to electrodeposit satisfactorily and which it was not possible to paint effectively. If a colour was chosen, it was not the right colour ; it changed colour for example when stoved.

He did not think that the part played by bright trim had been emphasised sufficiently. Without the bright trim it would be extremely difficult to change the colour effectively, and three-dimensional effects were certainly dependent on the judicious use of bright trim, be it stainless iron, chromium plate or the newer bright anodized aluminium, a material that the stylists and the colour stylists should take notice of and use wherever possible.

Reference had been made to the restricted field of interior trim. In the United States there was a far wider range of interior trim than in this country. If they could do it, it seemed that it could be done over here. Was it the fault of the stylists and the colour stylists or of the production people who could always find excuses why they were not able to do what was desired by the designer and the stylist.

He was interested in the reference to the need to choose the colours so that they showed up dirt ; that seemed to be a wrong concept. He would certainly not want them to show up dirt, but it was not a matter of the colour but of the choice and quality of the materials. Even with woven fabrics soil-resistant materials could be used, and with leather cloth soil resistance depended on the finishing procedure.

Personal bias in colour and styling was a real problem, and he ventured to say no two people at the meeting would agree as to which was the most likeable colour in any particular range of motor vehicle.

MR. G. G. E. ARNOLD (Hoover Ltd.) referred to colour and styling as being of paramount importance to the manufacturer of domestic appliances.

It was said in the paper that colours were dictated by fashion ; was it true to say that fashions occurred in cycles, and therefore it was possible to predict what would be the popular colours next year or the year after ?

Had any consideration been given to the internal colours of motor cars ? It had been established that colour in factories had an important effect on the efficiency of the workers ; did the colour in the interior of the car have any effect on the efficiency of the motorist ?

MRS. K. PETRE (The Austin Motor Co., Ltd.) said that it was generally considered that eye appeal sold a car. She would question the author's view that it was the man who did actually buy the car as she always understood that it was the woman. In the main, her company took a large cross-section of public opinion into account when styling new cars and voting came out as a rule in favour of two tones of grey ; that seems to be the predominating colour with No. 1 popularity. This had arisen from the fact that immediately after the war when cars were very scarce people took pastel colours that were being made for America, got to like them and found they were infinitely easier to clean than black cars.

MISS D. PILE (Metal Finishing Association) thought that the pastels or bright pastel colours showed up once they got a bit dirty and worn, far more than the rich colours. A shabby two-colour pale blue and pale beige car looked far worse than a shabby very dark crimson car. Therefore, it was good commercial practice, to sell more cars, to paint them in pastel colours. People immediately noticed when they became shabby and wanted to change them. With the more expensive cars

the "jewel" colours and black were used, black, of course, being a universal colour. On the other hand, in the most expensive ranges the richest people preferred different colours, but generally there was a black car amongst them.

DR. S. WERNICK (Consultant) thought that the best aspect of the paper was that for the first time in the history of the Institute it had brought together the stylists, the designers, and the metal finishers.

He did not know why it was that the two bodies who were essentially concerned with metal finishing of all parts so rarely met. Whether it was the fault of the management or whether it was deliberate policy that they should not mix, he did not know, but it must have occurred to all many times that it was rare for the metal finisher to meet the stylist or designer. He appealed for frequent meetings between them.

For that reason, he was a little disappointed that the paper dealt very little with the impact of styling on finishing. How far was the stylist prepared to consider the finisher's difficulties? Some caustic remarks had already been made on the subject, and he thought they were deserved. It was a constant problem in plating, where the most unsuitable shapes confronted the plater; and the same applied to the painter.

It was for this reason that the Institute had spent some considerable time recently on the preparation of a publication which it was hoped would guide designers on finishing problems and help them to appreciate the problems of the metal finisher. This publication would shortly become available and he hoped that it would make some impact on the industry.

Various reasons had been put forward for the selection of colours. He had often wondered whether it might not be just as well to draw them out of a hat as to go through the performance that seemed to be necessary before a decision on a range of colours was made. His own particular object in choosing the colour of a car was to have the most unobtrusive one he could find. The colour of his car was grey; it was a car which, when in a restricted parking area, would attract less attention.

MR. A. A. B. HARVEY (Vauxhall Motors Ltd.) said he had hoped that Mr. Neale would not restrict his paper to motor-car styling. The number of hours a day spent in contemplation of a motor car was very small, yet in our homes we were surrounded by an enormous number of things which were constantly in view and which must at some time or another have received the attention of the colour stylist. He was hoping to have heard something of a general pholosophy of colour styling as applied not merely to motor cars but to all articles of commerce.

Mr. Neale touched very lightly, indeed light-heartedly, upon the perennial question of the relationship of the artist to the community in which he dwelt, a relationship which applied equally to the unemployed artist starving traditionally in his garret or the motor-car stylist immured in Babylonian luxury.

Unless the artist could relate what he was trying to do to the needs of the community, he would be driven into the banalities of abstract art which conveyed no message to anyone, except that the artist was trying to express on canvas or through some other medium the workings of a brain which was better kept in the dark.

The question of applied art was very real. How far was the need of production facilitated and utility allowed to influence the work of the stylist? Clearly the more utilitarian the object on which he was working the more closely must he be guided by its use. It was no good having a strong emotional and aesthetic impulse to construct car parts that did not work in the right way. They had to be subjected to the needs of the job.

He saw a report recently which stated that pastel-shade cars were most largely involved in accidents between lights. Mr. Pollak had explained earlier how colours tended to go grey. Was that allowed to influence the choice of colour?

MR. I. S. MOLL (I.C.I. Ltd.) was interested to hear the opinion that styling came before colour. Colour styling, as he understood from the paper, was extremely important in putting the finishing touches to the styling of the car and creating a balance between styling and colour. If so, why was it that in America one saw a much wider colour range than in the U.K. Was the extra cost of an expensive coloured pigment such a big proportion of the cost of the car that this type of colour could not be used?

MR. M. J. ASHTON (Ashton and Moore Ltd.) mentioned the question of "texture." It was easy to have azure blues, but according to whether it was a stain, temper, etch or polish so was a completely different picture of the colour obtained. This applied not so much to the exterior as to the interior where there were fabrics of different sorts, aluminium bodies trimmed with different colours, carpets and different textures. Unless all the "textures" were similar the colours would appear to be of different shades.

It applied also to domestic articles, washing machines and so on.

VACUUM DEPOSITIONS OF METALS

By G. B. REMOND* and A. R. JOHNSON*

THE fact that thin metal films can be deposited on surfaces by vacuum techniques has been known for a considerable time. At present the possibilities of the method are becoming more and more apparent to industry and new applications are continually being recognized.

Applications

The following are some of the applications of the process.

1. Decorative finishes on artificial jewellery, toys and novelties, both metal and plastic.
2. Mirrors of all types, including semi-reflecting surfaces.
3. Lens blooming.
4. Reflectors for car lamps, electric torches and electric fires.
5. Resistive films.
7. Preparation of plastic and other non-conducting articles for standard plating techniques.

Suitable Coating Materials

In theory, any pure metal can be evaporated provided that its melting point is lower than that of the filament or boat used to hold it, and that sufficient current can be passed through the filament to produce the required temperature.

Aluminium is the most commonly used metal being both economical and comparatively easy to use in relation to this process.

Table I gives a list of the more widely used materials and indicates their melting points and evaporation temperatures at a pressure of 10^{-2} mm. of mercury.

Alloys such as aluminium-bronze and nickel-chromium can also be evaporated by this method.

Theory

If vapourized metal atoms are allowed to strike a surface with sufficient energy, and if that surface is at a temperature lower than the melting point of the metal, they will condense and produce a thin coating of the evaporated metal.

When a metal is melted, atoms close to its surface are liberated and leave the molten metal with considerable energy. They would travel in straight lines were it not for the presence of atmospheric gas molecules in the space around the molten metal. However, collisions, occur between the metal atoms and the gas molecules with the result that the evaporating atoms move about at random.

If the pressure above the surface of the molten metal is reduced, the number of atmospheric molecules is reduced. Hence, the lower the pressure, the greater the distance which the metal atoms are likely to travel without deflection due to collision. This collision-free distance is known as the Mean Free Path and its value depends upon the pressure of the atmosphere surrounding the evaporating source.

For all the metal atoms to strike the target with the same degree of energy, it is therefore necessary that it should be situated at a distance from the evaporating source less than the Mean Free Path.

These conditions can be fulfilled only if the melting and evaporation processes take place in a vacuum chamber at pressures below 10^{-2} mm. of mercury.

The process can be divided into five operations:

Table I

Material	Melting Point °C	Evaporating Temp. at 10^{-2} mm. Hg. Pressure.	Evaporating Source
Aluminium	660	1000	Tungsten Filament
Chromium	1900	1205	Molybdenum Boat
Copper	1080	1270	Tungsten Spiral
Gold	1063	1465	Molybdenum Boat
Nickel	1455	1510	Tungsten Spiral
Platinum	1774	2090	Tungsten Filament
Selenium	217	234	Molybdenum Boat
Silver	960	1047	Molybdenum Boat
Tin	232	1189	Molybdenum Boat
Magnesium Fluoride	1395	1400	Molybdenum Boat
Silica	1710	—	Molybdenum Boat

* *Metropolitan-Vickers Electrical Co. Ltd.*

1. Preparation and cleaning of the article to be coated.
2. Loading the work chamber.
3. Evacuation of the work chamber.
4. Evaporation of the coating material.
5. Protective lacquering and tinting.

Preparation of Surface

Thin metal films produced by this method will only reproduce the finish of the existing surface of the article being coated. If the object has a dull or matt surface the resultant finish will also be dull or matt ; on the other hand the film deposited into a highly polished or mirror finish will reproduce those qualities on the final surface.

In the past it has been necessary to polish a metal surface before coating in order to obtain a high-gloss finish. Although effective, the conventional methods of grinding and buffing are somewhat lengthy and costly and are not suitable where the surfaces are irregular. (*e.g.* artificial jewellery).

A more economical alternative has been made possible by the development of a range of special lacquers to give high-gloss finishes. The range covers lacquers suitable for both metals and plastics. Before coating, the lacquer is applied to the article, by dipping or by spraying, and then stoved. Besides producing a high-gloss finish these lacquers limit the quantity of gas liberated when the article is under vacuum and therefore minimize any adverse effect on the pumping cycle. The lacquers have a low vapour pressure which is further reduced by the stoving process and, under vacuum, do not liberate gases to any great extent. When using the lacquers, care must be taken to ensure that no " runs " or " tears " occur since these would be reproduced on the coated surface. Special dipping machines are available for this purpose.

It is essential that the lacquering and stoving processes should be carried out in a dust-free atmosphere, otherwise small particles will adhere to the surface and be visible in the finished coating. Stoving can be carried out in either convection or infra-red ovens at the temperatures recommended by the lacquer manufacturers.

Articles requiring a high-quality finish, such as headlamp reflectors were of necessity constructed of brass when coated without lacquering. The advent of the lacquering process has enabled the required finish to be obtained on a steel pressing with a consequent reduction in cost.

Cleaning

To obtain the best results, the surfaces on which the thin films are to be deposited should be chemically and physically clean. They should be free from contamination of any kind, but especially from greases. The effects of a surface which is not clean can be blemishes, bad adhesion and a longer pumping cycle. Different cleaning techniques must be used for different materials.

In the case of glass, an efficient method is to soak it in warm water to which a few drops of a detergent have been added. After thoroughly rinsing in running warm water, it is immersed in methyl alcohol and finally dried with a clean, dust-free cloth.

When coating on lacquered surfaces this degree of cleaning is not necessary but in all cases it is essential not to handle the articles with the bare hands more than absolutely necessary since this usually deposits grease on the surface.

For certain evaporation processes where a durable, hard and good quality finish is required, a high-voltage cleaning process is advantageous. The object is subjected to a discharge which removes adsorbed gas molecules and impurities before the film is deposited. The discharge takes place from two electrodes suitably situated in the vacuum chamber. The electrodes are at a high potential and the discharge occurs when the pressure in the chamber reaches a certain value.

Another method of removing adsorbed gases is by means of radiant heaters fitted inside the vacuum chamber. These operate from a low-voltage supply and should be capable of heating objects to temperatures of 400 to 500°C. When subjected to these temperatures the gases are liberated more readily and the pumping cycle is not significantly increased. This technique is used mainly when coating glass to ensure a good quality, hard film with strong adhesion. It may be used with other materials but care must be taken not to approach too closely to the melting point.

Loading the Work Chamber

Mention has been made of jigs or work-holders on which the objects to be coated are mounted in the vacuum chamber. The design of such jigs is largely dictated by the nature of the objects themselves but certain considerations are applicable in almost all cases.

The jig should be easily removed from, and replaced in, the chamber in order that it may be loaded outside the equipment. When the equipment is used on a production basis, two jigs should be used, one being loaded while the other is in the vacuum chamber.

When the items are of regular shape and only one side is to be coated (*e.g.* headlamp reflectors) a stationery jig will suffice, but in the case of irregularily shaped objects which require an overall coating (*e.g.* artificial jewellery) a rotating work-holder is a necessity.

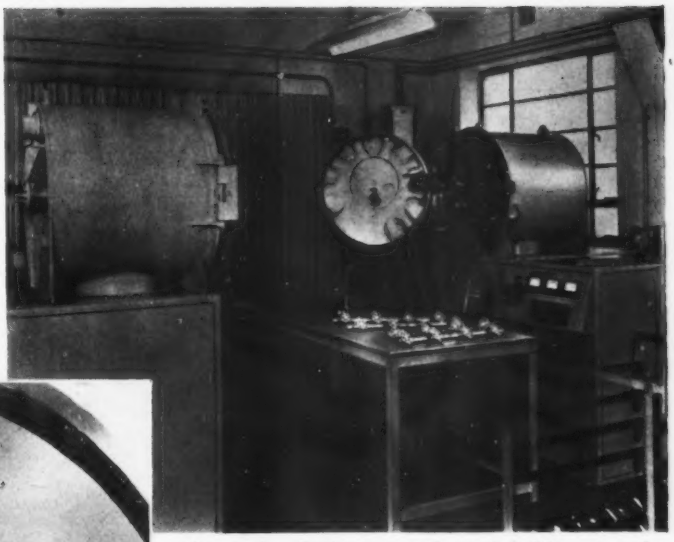
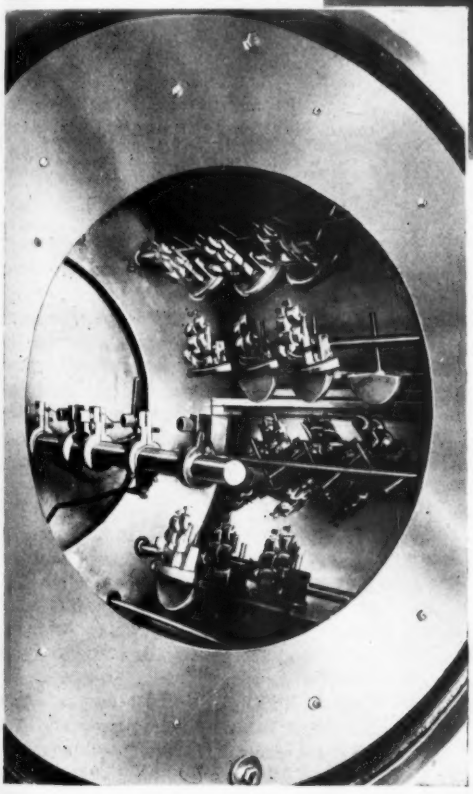


Fig. 1 (right)—The vacuum coating of headlamp reflectors showing the method of loading the vacuum chamber.

(Courtesy of Wipac Services Ltd., Bletchley)

Fig. 2 (below)—Plastic articles mounted on rotating shafts inside the vacumm chamber.



In designing work-holders, it should be noted that the atoms of the evaporating metal travel in straight lines. The object should therefore be mounted in such a way that straight lines from one or more of the evaporating sources strike each part of it.

Fig. 1 shows a vacuum coating unit in use for the coating of headlamp reflectors. The lacquered and stoved reflectors are attached to the work-holders which are then inserted into the jig inside the tank. Reflectors and work-holders can be seen on the adjacent table. In this case the work-holders are stationery.

Fig. 2 shows a jig loaded with plastic ornaments which are to receive an all-round coating. Each shaft in the jig therefore rotates on its axis being driven by a chain and sprocket mechanism situated between the rear end-plate of the jig and the rear wall of the work chamber. The method of mounting the articles on the work-holders is shown in Fig. 3.

Evacuation

The process is carried out in a vacuum chamber of glass or steel. The pressure to which this chamber is evacuated must be sufficiently low for the mean free path of an atom of the evaporating metal to be greater than the dimensions of the chamber. As these dimensions increase, a correspondingly lower pressure must be attained.

Generally, the pressures required are of the order of 10^{-3} to 10^{-5} millimeters of mercury. For example, at 10^{-4} mm. of mercury the mean free path is of the order of 20 in. which is adequate for most industrial coating. For more highly technical processes such as the production of waveguide attenuator vanes and telescope mirrors, the pressure is usually made much lower.

The chamber is evacuated by means of a diffusion pump backed by a suitable rotary pump, the rotary pump also being used for the initial rough pumping of the tank. Low-vapour-pressure oil is generally used as the working fluid in the diffusion pump although in certain cases mercury is used.

Since the chamber and its contents are frequently exposed to the atmosphere, they absorb impurities, the most important of which is water

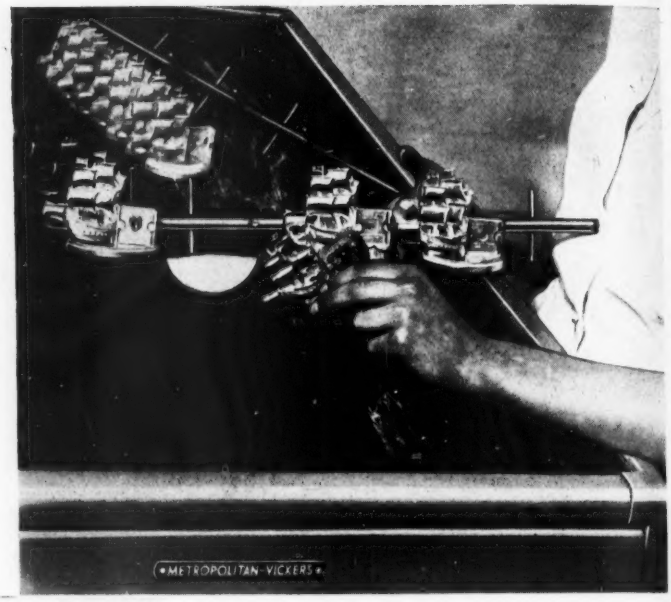


Fig. 3 (right) Plastic articles being mounted on the rotating shafts.

Fig. 4 (below)—A vacuum coating unit ; the vacuum chamber is 27 in. in dia. and 24 in. deep.

(Courtesy of Metropolitan-Vickers Electrical Co., Ltd.)

vapour. This is difficult to remove from a vacuum system. In addition the articles to be coated often contain adsorbed gases which are released as the pressure in the chamber is reduced. Lacquering, of course, minimizes this effect. This is particularly so in the case of plastics. For these reasons it is necessary to use high-speed diffusion pumps.

Evaporation

It is necessary to melt the metal under vacuum. The melting and vapourization temperatures will therefore be less than under normal atmospheric conditions.

The melting is normally carried out by passing a heavy electrical current through a filament or "boat" on which the metal to be evaporated is placed. The materials from which these are constructed must be low-resistance electrical conductors and have melting points higher than those of the evaporating metals. They must also be such that they do not readily alloy with these metals.

The most common materials used for such filaments and boats are tungsten and molybdenum. In the simplest form they consist of strips held between the terminals, the evaporating metal being placed on the strips. In order to retain the molten metal, it is sometimes necessary to indent these boats.

A widely used type of filament consists of a length of 1-mm. tungsten wire overwound by a further length of 0.3-mm. tungsten wire. The overwinding is merely a method of preventing the molten metal from dripping off the filament. When using this type of filament the evaporating metal is wound round it or hung over it in small lengths. The exact nature of the evaporating source will depend upon the circumstances and a variety of designs is available. Some examples are given in Table I. The current which has to be passed through the filament or boat depends on its resistance and the melting point of the metal at a particular pressure.

The thickness of the coating is generally between

3000 and 4000 Angstrom units (between 3×10^{-4} and 4×10^{-4} mm.) It can be increased by evaporating a larger quantity of the metal but this presents certain difficulties. It is not possible to build up the thickness by depositing further layers since this necessitates opening the chamber to replenish the evaporating sources and consequently permits oxidation of the existing film to take place. The result of this is poor adhesion. To increase the thickness of the coating it is therefore necessary to evaporate continuously from a source into which the material is continually fed without breaking the vacuum.

Protective Lacquers and Dye Tints

To protect the coating from wear and corrosion, a range of clear lacquers is available for application after the coating process.

The colour of the finished article then depends upon the metal which has been evaporated onto it. However, a range of dye tints has been developed which, when applied to the top lacquer, give the metallic finish a variety of colours.

In this way articles such as artificial jewellery, coated with aluminium, may be produced ingold or other colours.

Plant

A typical vacuum-coating unit on an industrial scale is illustrated in Fig. 4. The unit comprises a working chamber 27 in. in diameter and 24 in. deep mounted on a cubicle containing the vacuum pumping and measureing system, electrical and cooling water supplies and controls. The top of the cubicle adjacent to the chamber is used as a workspace.

In the door of the chamber are viewing ports and an air inlet valve to let the chamber down to atmospheric pressure after coating has been carried out. Inside are the evaporating filament terminals and the high voltage electrodes. Provision is also made for the connexion of radiant heaters. A rotary-type vacuum seal is provided in the rear wall of the chamber to enable a drive to be transmitted to a rotating work holder when required.

The vacuum pumping system comprises a Metrovac type 093 oil diffusion pump backed by a Type VSD778 rotary pump. Between the diffusion pump and the vacuum chamber is a baffle plate valve which can be closed to isolate the vacuum system when the chamber is let down to atmosphere. This enables the pumping system to remain undisturbed while the chamber is re-loaded. A by-pass line from the rotary pump to the chamber enables the chamber to be rough-pumped again before opening the baffle valve and resuming the pumping cycle. In this way the pumping cycle is kept short. The valves are controlled by two handles at the front of the cubicle.

Vacuum gauges are incorporated to measure the pressures, these being indicated on two instruments on the control panel at the front of the cubicle. Vacuum relays, switches, and valves are included for protection of the equipment in the event of power or water supply failure.

Control of the evaporation filament current is by means of a Variac autotransformer and the current is indicated on the third instrument on the control panel. The Variac control handle is mounted on this panel. Also on the control panel are the rotary and diffusion pump switches, the evaporation or high-voltage cleaning selector switch, the rotating jig mechanism switch, various indicator lamps, and fuses. The equipment operates from a 400/440-volts, 3-phase, 50-cycles supply and a water supply for cooling the diffusion pump is necessary. The unit is designed for operation by semi-skilled labour.

Procedure for Coating

The procedure adopted varies to some extent with the nature, size and quantity of the items to be coated, but the general sequence is as follows :

1. Prepare the surface by cleaning and/or stove lacquering.
2. Charge the filaments or boats with the metal which is to be evaporated.
3. Load the items to be coated onto the jig and place it in the vacuum chamber.
4. Evacuate the chamber.
5. If a high voltage is to be used, energize the electrodes when the appropriate pressure is reached.
6. When the pressure reaches the evaporation value (usually 10^{-4} mm. of mercury or less), and if radiant heat is to be used, energize the heaters.
7. Energize the filaments to evaporate the metal.
8. Let down the chamber to atmospheric pressure and remove the coated articles.

The time taken to carry out the operations 4 to 8 inclusive depends upon the nature, size and quantity of the articles but is of the order of 10 minutes with the chamber fully loaded.

Conclusions

The process offers an economical alternative to standard plating techniques. The capital outlay is not high, and running costs are low. Operation of the equipment is simple and highly skilled labour is not necessary.

It will be appreciated that the applications of the process are extensive and varied. They are, as yet, by no means fully realized and the investigation of new possibilities offers an interesting range of problems.

NEW TYPE OF CONTINUOUS ELECTRIC ENAMELLING FURNACE

Major Improvement in Enamel Quality Claimed

A NEW type of continuous, electric enamelling furnace of 750 kW. capacity, which, it is claimed, will give a major improvement in the quality of enamelling produced with the minimum of rejects, has been installed at the works of Belling and Co. Ltd. at Enfield, and has been in operation since January.

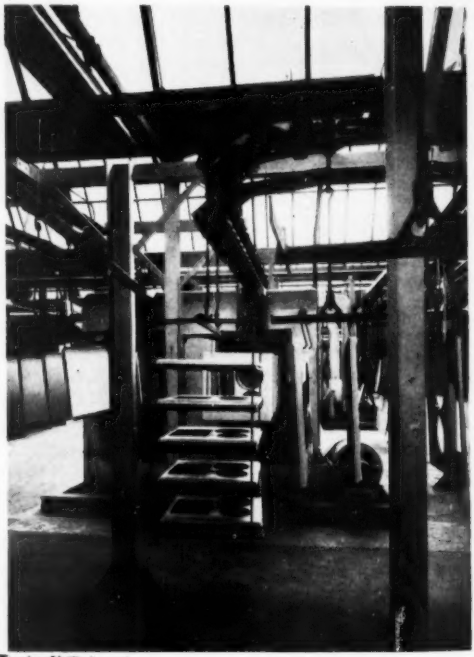
The particular design of the furnace, developed and built by Ferro Enamels Ltd. of Wolverhampton, is said to have diminished all undesirable furnace conditions as well as reducing maintenance to a purely nominal degree for the first ten years.

Installed on the centre-line of the furnace in the burning chamber is a centre wall to carry part of the elements; this feature provides for wide distribution of the elements and thereby ensures even temperature conditions throughout the chamber.

An outstanding advantage of the furnace is its improved heating distribution which has been achieved by spreading the loading elements over the furnace walls and floor, to predetermined and calculated figures based on previous experience and operational test curves and results.

A further point of note is the furnace's economy of electricity, brought about by uniform heat distribution in the pre-heat zone. This has been made possible by a specially designed hot-air inner air seal; between the inner air seal and the interior air seal is installed a hot-air convection system which draws the recirculated air over the outgoing ware, thereby providing a cooling effect on the outgoing ware and a more rapid pre-heating of the ingoing ware.

The furnace is rated at 750 kW. on 415-volts, 3-phase, 50 cycle supply and is balanced over the three phases. To adapt the furnace to varying production requirements and to take advantage of all possible efficiencies in operation, the hot zone is divided into five sections.



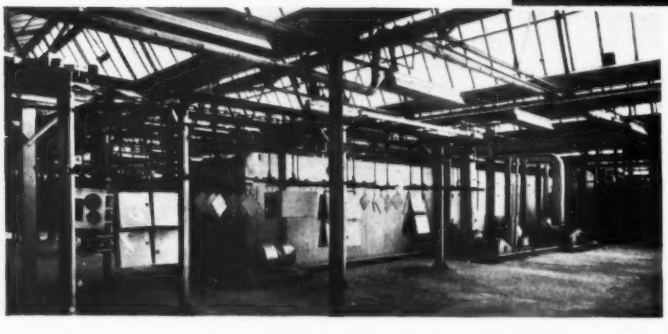


Fig. 1. *(left) Side view of new 750-kW. Ferro electric furnace showing enamelled ware and conveyor system.*

Fig 2.—*(above) Front view of Ferro electric furnace showing cooker parts entering and leaving the furnace on the 150-ft. conveyor chain.*

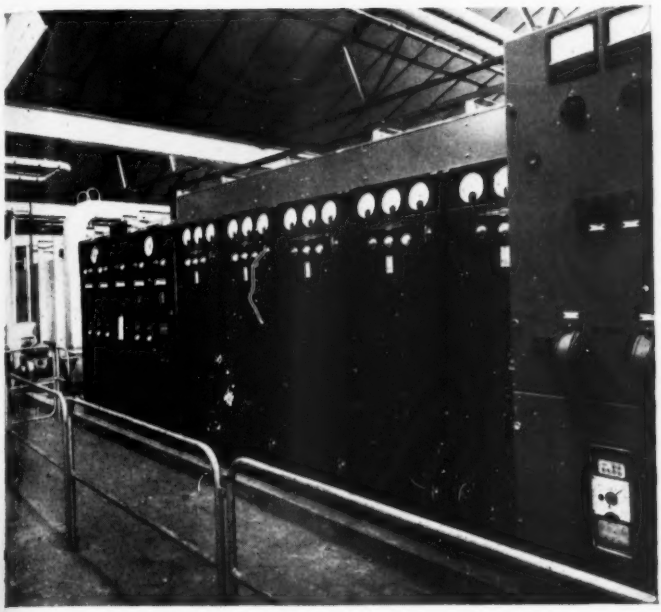


Fig. 3—The five temperature indicating and controlling pyrometers and one six-point recording pyrometer mounted on a box-type cabinet. Installed alongside the control panel are separate panels carrying the contactors, the fuse board, isolator switches, power connexions and ammeters.

The heating elements are mounted on both sidewalls of the hot zone, both sides of the centre wall and in the floor. Floor elements are protected by cast nickel-chrome, heat-resisting alloy grids. Heating elements are of nickel-chromium ribbon, approximately 1 in. wide and 1/10 in. thick and formed in loops which are supported by aluminous porcelain insulators built into the sidewalls of the hot zone.

There are five separate temperature control zones for each bank of elements. The furnace is designed for a maximum operating temperature of 880°C. Should the temperature exceed this the supply current is cut off immediately as temperature limit fuses are installed in each element zone.

In all there are five temperature indicating and controlling pyrometers and one six-point recording pyrometer all mounted on a box-type cabinet complete with signal lights. Also mounted on the pyrometer cubicle is one dial-type conveyor speed indicator and remote variable-speed control, an 8-in. diameter clock and all the flush-mounted panel starters for the furnace motors.

Installed alongside the control panel are separate box-type panels to carry each contactor, where also are installed the fuse board, isolator switches, power inlet connexions and ampmeters.

The front of the furnace consists of 20 feet of 4-in. insulated sheet-metal panel construction. At the entrance to this section, is installed the very latest type of exterior air seal. The air is re-circulated through the system by means of a high volume capacity fan, which provides low-velocity horizontal air curtains from each side of the panel section, which is then collected by a vertical centre duct for recirculating through the system.

The other 50 feet of furnace is of steel-frame construction having an outside casing of $\frac{1}{8}$-in. plate. The walls and floors are of hot-face insulation backed up with other suitable grades of insulation material to give the greatest heat conservation.

This furnace incorporates the well-known "Ferro" cross-ventilated bottom construction which has been a feature of all their other furnaces. The roof is of the well-known suspended type, but incorporates the new "Ferro" fully floating tile in the firing zone, so that the side tiles are not now dependent on the main furnace walls for partial support. This feature eliminates the need for any roof rod adjustment when the furnace is shut down over week-end or holiday periods.

Another feature of this new style of roof construction, is the revised slot design, which gives a much higher insulating condition than any of the other types at present in use.

A conveyor chain extension of 150 feet in front of the furnace is provided for loading and unloading the ware. The 90-degree roller turn incorporated is supported from overhead and the rollers in the tension take-up turn are of the ball-bearing type. The turn in the furnace hot zone is of the traction-wheel type and consists of a sprocket, shaft and bearings mounted on a floating support to allow for easy alignment with the furnace roof slot, and revolves on carbon bushes and rings.

AUTOMATIC HYDRAULICALLY OPERATED ELECTRO-PLATING PLANT

NEW INSTALLATION AT THE WORKS OF MODERN ELECTRO PLATING (KENT) CO. LTD.

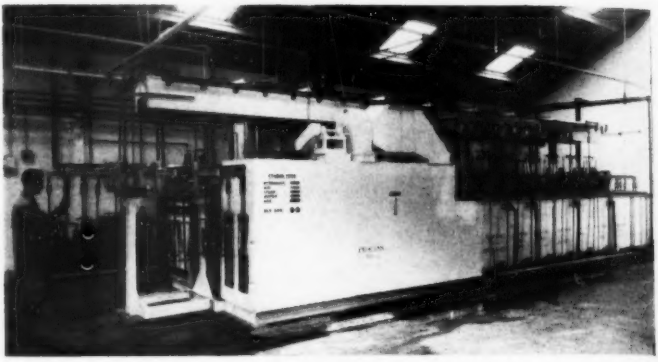


Fig. 1.—Side view of plant showing unloading station with work emerging from the drying oven

A NEW automatic cadmium-plating plant which is completely hydraulically operated has recently been installed at the Slade Green, Kent, works of Modern Electro Plating (Kent) Co. Ltd.

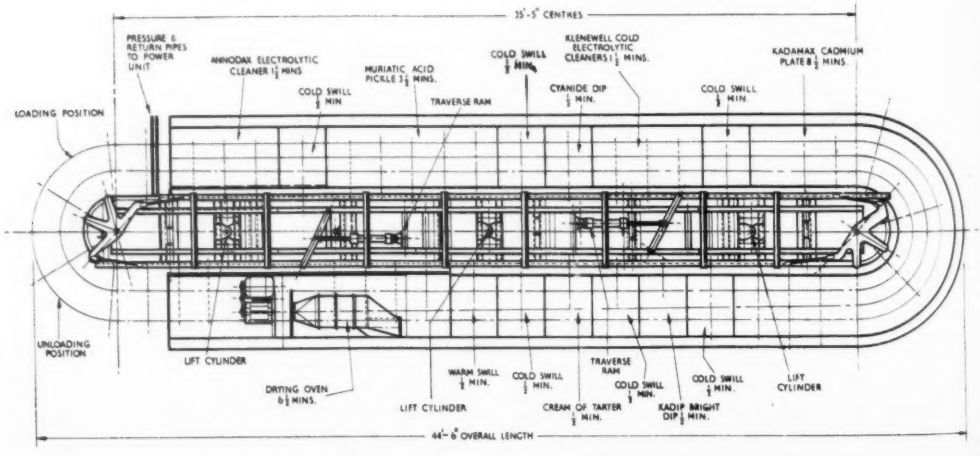
This company, formed in 1948 with a share capital of only £1,400, was started in a small factory in Chislehurst, Kent, with the main purpose of specializing in cadmium and zinc plating for the radio and electronic industry.

Over the past 10 years, recognition in this sphere has been obtained by continued experiment and investigation into the behaviour of these metals under all types of conditions, and throughout the years the capacity for this type of plating has increased to such an extent that unlimited quantities are now being handled by mass-production methods. Alongside these processes a large barrel plating installation has grown, together with anodizing, bright and hard chromium, and all other types of finishes.

Several successful experiments with silver, hard and bright gold, and rhodium, have led to results which have been accepted by the electronic industry and which are now in general use.

During the first few years of its existence, the company steadily expanded and it was eventually found necessary to acquire a larger factory. After great difficulty, suitable premises were found in 1952 in a disused power station at Slade Green, Kent, and the company was in full production

Fig. 2.—Plan of plant showing layout of tanks, process times and position of traversing and lifting gear.



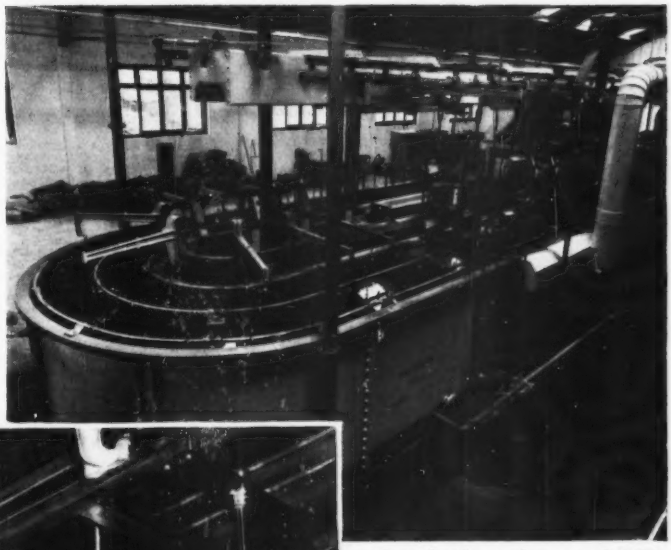
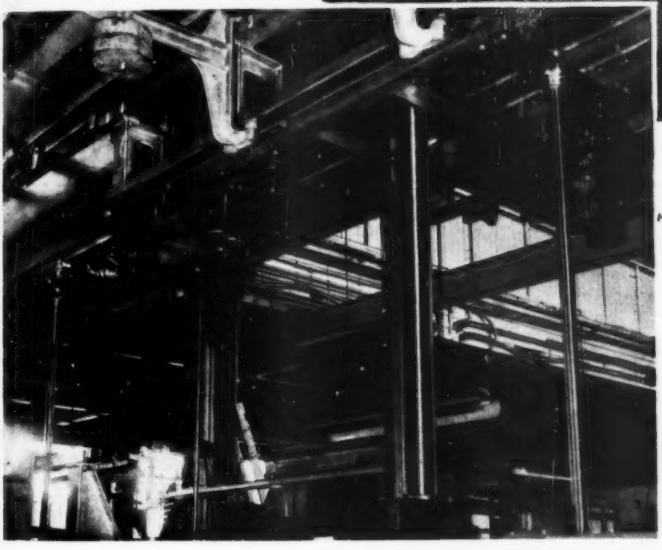


Fig. 3.—(right) This shows the cadmium plating section of the plant.

Fig. 4.—(below) A detailed view of the centre unit showing the carriage in the raised position. One of the hydraulic lift cylinders with its rack is in the foreground. Two telescopic feed pipes can be seen, one on either side of the hydraulic cylinder. In the left centre of the photograph is the traverse valve and its operating mechanism.



there in the early part of 1953. Some twelve months later, an additional plating shop, polishing shop, and stores, had to be built on to the existing factory.

In September 1957, it was felt that automation was needed to give the necessary capacity and firms in England, Germany and the U.S.A., were approached with a request for the design of an entirely new type of plant suited to the particular requirements of the company, and W. Canning

(*Continued in page* 402)

Fig. 5.—(right) View of plant from the loading end. In the left foreground is the pump unit for operating the hydraulic gear.

Hydraulically-operated Plating Plant

(*Continued from page* 401).

and Co. Ltd., of Birmingham were finally asked to undertake the construction of such a plant. While the plant was still on the drawing board, the radio trade suffered a serious recession but the policy of the firm has always been one of progress and at no time was consideration given to the idea of delaying installation.

To house such a machine, an additional new factory of 6,000 square feet was planned, incorporating acid-resisting floors and special methods of effluent disposal to handle the large quantities of water required. A feature of this building is that vans are able to drive straight through, thus being able to load work direct from the automatic plant, thereby reducing handling to a minimum and facilitating quicker delivery times.

This company is one of the few outplaters in England to instal fully automatic plating plant, and claim that they are the first outplaters to instal a fully automatic cadmium-plating plant in Europe.

Careful time and motion study was carried out and the results fully justified all expectations. The company claim that they are now in a position to produce cadmium and zinc plating at guaranteed Ministry specifications as a commercial proposition, on a highly competitive basis. Commercial cadmium and zinc plating have been revolutionized to such an extent that time and costs can, in some cases, be reduced by as much as 50 per cent.

The company also extends its progressive policy in other directions and always endeavours to cement a relationship with its customers whereby the customer has faith in his metal finisher. An efficient technical service is open to all and sundry in an effort to encourage the high standards of metal finishing which, it is felt, will result in the ultimate benefit of industry as a whole.

Use of Hydraulics

The new unit is the first production example of an automatic plating plant employing a completely hydraulic system of operation. Hitherto operation has been by either electro-mechanical or electro-hydraulic systems. Each system worked well within its limitations but the new development is probably the most interesting advance in operation since automatic plants were first designed.

The new plant has a compact centre section which dispenses with the normal permanent central structure extending above the tank level. The centre unit consists of a simple system of hydraulic lifting cylinders pushing underneath the carriage so raising it to give the required clearance for the transfer of jigs from tank to tank. The lifting cylinders operate on a low-pressure hydraulic system through mechanically operated valves, and are interlocked by a rack-and-pinion mechanism which ensures that they are permanently in phase. There are no flexible connexions, the pressure and return lines being carried by telescopic tubes.

Transfer Mechanism

Transfer of plating jibs is effected by hydraulically operated traverse bars ; conveyor chains, counter-balance weights and solenoids are entirely dispensed with and the number of limit switches used has been reduced to one single unit, therefore the sources of possible de-synchronization are eliminated. The carriage itself is notable for the clean line on the upper surface and its simple yet rigid construction. As will be readily understood, traverse bars are not subject to the stretch which is sometimes troublesome with a system of chains therefore the whole system is fully positive in operation. Each transfer can be independently adjusted as the position of the tanks in the plating process require. The hydraulic gear which operates this lift and traverse mechanism is carried on the centre structure independently of the process tanks and is powered by a motor unit remote from the plant. The only parts of the unit which overhang the tank in any way are the work arms which carry the plant jigs. This is an obvious advantage from the point of view of reducing corrosive attack on operating mechanism, carriage gear and supports. It also fully eliminates the possibility of solution contamination by oil dripping into it. The tanks around the plant are fabricated in units which are designed to enable them to be easily withdrawn from the process line at any time in order to enable inspection and maintenance to be carried out.

The process sequence is under the control of an electronic timer, thus it will be seen it is impossible for the plating process to go out of any sequence once it has been set.

In order to facilitate transportation and erection, the centre unit containing the operating mechanism is built up from sections which are easily coupled together to form the complete unit. On despatch from the assembly shops, the sections are despatched independently as separate units. They are then reassembled on site in the minimum of time and with the minimum amount of labour. The process tanks are supplied, as previously mentioned, in compact units in suitable sizes for easy handling. Handling and transportation have been kept very much in mind in the design of these new units and they are able to be broken down into sections in order of 12 ft. x 6 ft. x 3 ft. The plant was delivered at Modern Electro Plating Ltd. in May 1958, and in less than six weeks was erected, by the company's own staff, tested, handed over and had settled down into full routine production.

FINISHING NEWS REVIEW

INSTRUMENTATION SYMPOSIUM

THE joint symposium on instrumentation and computation in process development and plant design, organised by the Institution of Chemical Engineers, the Society of Instrument Technology, and the British Computer Society, under the aegis of the British Conference on Automation and Computation, is to be held at the Central Hall, Westminster, London, S.W.1., on May 11-13, 1959, and not April as stated on the official programme.

Enquiries to The Institution of Chemical Engineers, 16 Belgrave Square, London, S.W.1.

WARRINGTON PLANT

AT the annual general meeting of Firth Cleveland Ltd., the chairman, Mr. C. W. Hayward, announced that a new factory for the Firth Company Ltd., Warrington, built to replace the one destroyed by fire in December, 1957 had been brought into production from September 1.

The new building is a reinforced concrete structure, designed by Mr. Charles McIntosh, the architect, in co-operation with the design department of Richard Hill Ltd. of Middlesbrough, who also supplied the reinforcement used on the contract. Acid-resistant paint and lead for the windows was supplied by British Lead Mills Ltd.

I.M.F. ONE-DAY SYMPOSIUM

November Meeting in London for Electroplaters

THE London branch of the Institute of Metal Finishing, have announced a one day symposium on Technical Control in Electroplating at the Charing Cross Hotel, Strand, London, on Wednesday, November 19.

The Institute says that members and friends from all areas will be very welcome at this meeting.

Programme

The conference will open informally at 10.15 a.m. for registration. Coffee and biscuits will be served.

MORNING SESSION

1. 'Chemical analysis of plating solutions' by K. E. Langford.
2. 'Control of electrodeposition processes by examination of deposits' by T. E. Such.

AFTERNOON SESSION

3. 'Trouble shooting in the plating shop' by C. F. Corfe.
4. 'Requirements and inspection of metallic finishes for service use" by D. W. Smith.

A buffet lunch will be available at the Charing Cross Hotel between the morning and afternoon sessions. Admission to this is by ticket only, which should be applied for as soon as possible.

Tea and biscuits will be served at the end of the afternoon session so that informal discussions can take place.

Duplicated copies of the papers will be sent to all registered members before the meeting as the papers will only be presented in a shortened form to enable the fullest possible discussion.

Applications should be addressed to Mr. S. W. Baier, 9e Cleveland Road, London, W.13.

Training For Graduate Engineers

A RECENTLY issued printed sheet "Note on Graduate Training in Chemical Engineering" has been prepared by the Council of the Institution of Chemical Engineers in consultation with the Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers Association.

The Institution has long recognised the need for training after graduation on the lines indicated in the note, but it was only in 1957 that the Ministry of Labour and National Service extended deferment arrangements to bring chemical engineering graduates into line with other engineering graduates who were given a deferment of call-up to allow them to undergo 2-year post graduate apprenticeships in industry. Since then there has been a rapid increase in the number of schemes for chemical engineering graduates.

The note is available from the Institution at 16 Belgrave Square, London, S.W.1.

SUGGESTION SCHEMES IN INDUSTRY

MORE than 400 suggestion schemes are known to be operating in British industry, and the number is growing steadily, says the Industrial Welfare Society. The rapid development of this method of channelling and rewarding employees' ideas for improving products, methods and services can be helped by posters to stimulate interest in companies' suggestion schemes.

So the Society has established a new service to industry — posters, published at regular intervals, 15 in. wide by 20 in. deep, large enough to be read at a distance but small enough to go on a works notice board. They are screen printed in two, three, four and five colours on stout paper. Some of them incorporate the work of famous cartoonists, like David Langdon and Jak; others use striking fluorescent inks. Six designs are available now.

The IWS is also organising a national suggestion schemes conference to be held at the Grand Hotel, Brighton, from October 31 to November 2.

AGENCY FOR LAPPING TOOLS

THE sole agency in this country for a range of new lapping tools and accessories, Macolaepp handlaps, wheels and paste made in Germany, has been undertaken by B. O. Morris Ltd. of Coventry.

The Macolaepp handlaps and wheels, cheap and easily replaceable, greatly improve tool performance after grinding and also prolong the life of the tool, the company says.

SALES CAMPAIGN BY V.E.D.C.

LAST month, this journal reported the introduction of a warrant to guarantee good service of goods manufactured by the member firms of the hollow-ware division of the Vitreous Enamel Development Council.

The council has now introduced a poster for display in ironmonger's shops throughout the country. Aimed at the housewife, it lists 12 salient points about the advantages of vitreous enamel as a finish for many kinds of household items. The poster invites enquiries for free information from its Enamel Advisory Service, and has a bold slogan — "remember, there is no substitute for genuine vitreous enamel."

The V.E.D.C. was formed just on two years ago as an association of companies from many sides of the industry to publicize the merits of the material and to maintain a quality control by establishing minimum manufacturing standards.

At a press conference held recently in London, Mr. N. F. Parker, chairman of the frit division of the Council, reviewed the progress made during these two years. On view were a number of typical applications of the process, some well-known examples like a gas-cooker and a washing machine, others not so well-known, like the huge coat of arms of Herefordshire, knocked for six from its mounting in Paddington station when a train ran into the buffers recently. The plaque, one of many that adorn the Western region terminus in London, was none the worse for its rough treatment.

Quality Control

Explaining why the council is so particular about quality control, Mr. Parker said it was partly because in all high quality products it was essential that the quality should be maintained as its most jealously guarded possession. "Much confusion in the public mind has been caused by the use of enamel applied to finishes quite different in quality from vitreous enamel, and as a result our industry has suffered greatly by

(*Continued in page* 410)

M.F. DETROIT CONFERENCE

U.K. Personalities in Early List of Speakers

THE International Council for Electrodeposition, through its chairman, Mr. Walter L. Pinner, has now released a tentative list of speakers and subjects for the fifth international conference on electrodeposition and metal finishing that will take place in Detroit during the week of June 15, next year. The conference will be the educational portion of the golden jubilee convention of the American Electroplaters Society, and there will be a comprehensive display of equipment and processes in its metal finishing exposition.

Speakers from the U.K. include many well-known personalities in the industry. Their papers will be: "European bright anodizing practice," by A. W. Brace (Aluminium Laboratories Ltd.). "Experience with the use of the sulphur dioxide test," by Dr. J. Edwards (The British Non-Ferrous Metals Research Assocn.). "Shot peening and baking effect on chromium plated steels," by R. A. F. Hammond (past president, Institute of Metal Finishing). "A critical study of accelerated weathering of organic finishes," by A. A. B. Harvey. "Grain size control in electro-forming," by A. D. Hughes. "Pyro-phosphate zinc plating," by U. F. Marx (Wilmot Breeden Ltd.). "Comparison of British and U.S. methods in organic finishing," by Dr. W. Stein and D. H. Lloyd. "Barrel plating with special consideration to protection of thread diameters," by A. W. Wallbank (Ionic Plating Co. Ltd.). "Problems encountered in the application of pre-coated steel," by Dr. S. Wernick, (hon. secretary), I.M.F.

In addition, speakers will attend from many other European countries and from the U.S.A., Canada and India. A paper to be presented by one of the German delegates, H. Guinsberg, is entitled "Developments in coating of aluminium and its alloys." From the United States, one of a large number of speakers will be R. A. Boller, who will present "water soluble and water reducible coatings for metals". Another American speaker, Dr. A. K. Graham, is to deliver a paper entitled "Black chromium plating."

COMMERCIAL PRODUCTION OF POLYMERS

AS a result of the success of the initial stages of a research project into the nature and properties of phosphonitrilic chlorides, Albright and Wilson (Mfg.) Ltd. say it is now commercially practicable for them to separate the trimer and the tetramer from the crude mixture of cyclic and linear polymers. Sample quantities of pure trimer and tetramer are already available, and greater quantities will be available shortly. Albright and Wilson claim to be the first chemical manufacturing company in the world to announce that they can separate the polymers on a commercial scale.

In recent years, the phosphonitrilic series of inorganic polymers has attracted increasing attention from research chemists. This has been largely due to the demand for high-temperature resistant materials, such as would be used in rocket and space research where materials have to maintain their properties in spite of exposure to extremely high temperatures.

Some years ago, Albright and Wilson were among the pioneers in the U.K. in the manufacture of a major group of semi-organic polymers — silicones. The phosphonitrilic compounds have several similarities to silicones and the company are hopeful that a wide range of heat-resistant materials — in addition to other products — will be developed from these.

At the meeting of the British Association, held in Glasgow recently, Mr. N. L. Paddock, in charge of research in this field for Albright and Wilson, described in detail the work carried out by his team.

TIN RESEARCH FOR U.S.

DR. W. E. Hoare, assistant director of the Tin Research Institute left for the U.S.A. and Canada on the "Empress of Britain" at the end of last month.

Dr. Hoare will be visiting important centres of tinplate production in the Chicago and Pittsburgh areas and will be particularly discussing research and new developments, during his month's visit.

Details of some of the new processes and methods developed by the Tin Research Institute at their Greenford (Middlesex) laboratories will be described by Dr. Hoare to representatives of American industry.

Polythene Powder Coatings

Growing Range of Applications During Recent Years

CHEMICALLY inert, non-polar, non-ionizing, polythene has been known and used for many years as insulation, and as protection against corrosion. Its availability, during recent years, in the form of a fine powder, has considerably increased its range of applications.

Using polythene powder as a dip or sprayed coating, a complete protective covering can be applied in one operation to metal articles of the most complex shape, such as the soap and sponge rack shown below. Dip coating, in particular, is a process which can be carried out with very simple equipment and it is adaptable to mass production requirements.

Precipitated as Powder

The conversion of polythene granules to a powder sufficiently fine for coating purposes dates back to 1942 when a research worker in the laboratories of the Telegraph Construction and Maintenance Co. Ltd. (Telcon) discovered that polythene dissolved in hot benzine was precipitated on cooling, not as an agglomerated mass, but in the form of a fine "snow." This, when freed from residual solvent, proved to be a powder finer and more uniform than any obtainable by using known milling or grinding methods.

But wartime restrictions on polythene prevented the commercial exploitation of the discovery, and it was not until 1946 that the process was brought to the notice of Schori Metallising Process Ltd. (now the Schori Division of F. W. Berk Ltd.), who began using the powder for spray-coating metals as a protection against moisture and chemical attack.

The powder was marketed by Telcon as "Telcothene" (B.P. 571, 814); it is now being used more and more extensively for coating such things as laboratory equipment, tanks for storing corrosive liquids and pastes, domestic articles fashioned from wire, and for a wide variety of applications where the insulating properties and toughness of polythene, not to mention its decorative virtues, are utilized. The powder can be produced in an almost limitless range of colours. Although not new, some notes on the two principle methods of applying the coating should be of interest.

Methods of Application

Dip coating consists of heating the article to be coated to a temperature above the melting point of polythene, immersing it in the powder, removing excess, and fuzing the adherent powder to a smooth even coating.

There are two main variations to spray coating. In one, the polythene powder is sprayed cold onto the heated article; in the other, known as flame-spraying, it is fuzed into droplets in its passage through the spraying device, the droplets coalescing into a uniform coating as they strike the surface to be coated.

The condition of the metal surface is of prime importance in ensuring good adhesion of the coating. The adhesion of polythene to copper, brass and lead is poor, and, if possible, a coating on these metals should completely surround the coated portions so that as it contracts on cooling it grips tightly. Sand or shot blasting of copper and brass improves adhesion, and the surface should be free from grease and oils.

Polythene coating of sponge racks on production line, Durable Plastics Ltd. Guildford

Aluminium also Suitable

Aluminium gives remarkably good adhesion to polythene coatings if the surface is first cleaned. The oxide film on aluminium appears to be an essential factor in the formation of a strongly-adherent coating. Adhesion to sheet iron can be improved by shot or sand blasting, the application of a phosphate film, or a combination of both. Alternatively, a granular coating of zinc, applied by flame-spraying, not only gives an ideal key for the polythene coating, but gives double protection against corrosion.

Articles incorporating soft-soldered joints obviously cannot be coated, as the temperatures employed are high enough to melt the solder. Joints in articles intended for polythene coating should be hard-soldered, or, better still, brazed or spot-welded. On the other hand, large welded areas should be avoided, as the coating does not adhere well to these.

Simplified Dip-coating

An elementary form of dip-coating can be carried out provided the article can be heated to a temperature of 160-200° F. When this has been done, the article is immersed in a quantity of polythene powder sufficient to cover it completely, then worked through the powder for a few seconds to ensure that all parts receive a uniform coat, an important part of the operation. In mass production adaptations of the method

(*Continued in page* 409)

COMPRESSOR IN THE ANTARCTIC

THE ability to " stay put " played almost as important a part as the ability to move during the recent trans-antarctic expedition, led by Dr. Fuchs. And the work done at the base camps, though less spectacular, was just as vital to success.

Details of an interesting aspect of the construction of the now famous Scott Base, together with an unsolicited testimonial of the quality of British engineering products are contained in a report from the Ross Sea Committee of the Trans-Antarctic Expedition.

The testimonial has been sent to Alfred Bullows and Sons Ltd., Long Street, Walsall, and refers to their Hydrovane " 60 " air compressor mounted on a Ferguson tractor. The writer was Mr. J. E. Hoffman, a drilling and explosives expert, who

(*Continued in page* 410)

BERYLLIUM PLANT FOR U.K.

I.C.I. to Establish the First in Europe

THE Metals Division of Imperial Chemical Industries Ltd., is to establish the first plant in Europe for the production of wrought beryllium. The plant is designed to produce semi-fabricated forms of the metal, such as rod, tube and plate, and finished machined parts. Its first task will be the execution of a production scale contract placed with I.C.I. by the United Kingdom Atomic Energy Authority (Industrial Group) as part of a nuclear development project. Subsequent spare capacity may find additional outlets for this unusual metal, as for example in the aircraft industry.

Interest in beryllium as a nuclear engineering material has been intensified by the need for a metal which will perform satisfactorily in the higher operating temperatures envisaged in gas-cooled reactors. For the present programme of British reactors, operating at temperatures up to about 470° C., special magnesium alloy materials are used for sheathing the nuclear fuel. For the higher temperatures needed to obtain increased thermal efficiency, materials with greater strength at these temperatures must be used and one of the most promising of these is beryllium.

With a melting point of 1280° C., the metal is light in weight, has good mechanical properties and good corrosion resistance to carbon dioxide at elevated temperatures. In addition, beryllium has by far the lowest neutron absorption cross-section of any of the possible constructional metals. For this reason, the Industrial Group, U.K.A.E.A., intends to use beryllium fuel cans in its advanced gas-cooled reactor, in which fuel element surface temperatures as high as 600° C. are planned.

The handling and fabrication of beryllium involve specialised techniques to overcome difficulties arising from its particular metallurgical characteristics and from the toxic properties of the metal in certain compounds and forms. The I.C.I. plant will incorporate all the special features found necessary for this purpose.

Some unusual features are involved in the manufacture of wrought forms of beryllium. The metal, received as flake or as small beads, is melted under vacuum in induction furnaces to produce an ingot. This is really a refining process : the cast ingot, having a large grain size and very poor workability, cannot be rolled or extruded directly in the same way as conventional metals are. It has to be made into fine powder which is then heated and compacted under vacuum to produce the various shapes required for further processing by conventional plant.

I.C.I. has already made considerable contributions to the development of nuclear metallurgy, in much of the early work of nuclear engineering.

The potential uses of beryllium are not confined entirely to nuclear engineering, and there is a considerable long-term interest in the metal among aircraft and missile designers. Its very low density and high tensile strength make it a promising material for aircraft skinning. It is, in fact, reported that beryllium is being used in this way in North American Aviation's latest research aircraft X-15, designed to fly at speeds up to Mach 7.

From the viewpoint of the engineering designer, the metal's most attractive property is its high strength/weight ratio ; it has a density little more than half that of aluminium and a stiffness four times as great.

ANODIZED ALUMINIUM IN LLOYD'S BUILDING

THE great increase in insurance in recent years necessitated a move by Lloyd's earlier this year to a new building in the City of London. In the view below of the underwriting room gallery can be seen the aluminium alloy semi-circular headed windows and decorative fittings, part of more than 100 tons used in the new premises. At the business peak in the underwriting room, upwards of 4,000 people might be present, and to accommodate these the new room is about 340 ft. long by 120 ft. wide. The aluminium work was by James Gibbons Ltd., from metal supplied by Northern Aluminium Co. Ltd. It was anodized to a satin-silver finish, and to ensure colour matching, the same alloy, HE 10, was used throughout.

CONSENTS FOR TRADE EFFLUENT

Sliding Scale System Introduced to Birmingham

ALL the activities of local authorities in controlling trade effluent are directed to a single end — the cleansing of the nation's rivers. This is a matter of immediate social importance, but, in addition, if the end is not achieved, the time will certainly come when our rivers will be unable to meet the ever increasing demand of industry for clean water.

The experience of the Birmingham Corporation is that industrialists are becoming increasingly aware of the importance of reducing pollution.

Under the 1937 Act, local authorities can charge traders for the reception and treatment of trade effluent ; Birmingham has devised a sliding scale system so that a trader's costs in this respect are directly related to the strength of the effluent he actually discharges during the year.

Thus, the trader has a financial incentive to reduce the strength as well as the quantity of his effluent. The experience of other local authorities is that the fairness of such a system enlists the traders' sympathetic co-operation.

It has been common experience that, where a sliding scale of charges is used, industrialists have often been able to make savings in their own manufacturing costs. Until their attention is drawn to it by a charging scheme, manufacturers often do not realise how much the unnecessary waste of water and chemicals is costing them.

Consents for the discharge of trade effluent in Birmingham can now be issued containing conditions for a variable charge. In practice the charge is calculated twice yearly, the basis being the strength of the effluent as analysed by sampling during the period and the ascertained cost of treating average sewage at the drainage board's works ; the cost of conveyence in the sewers is also included.

The size and urgency of the problem in Birmingham made it impracticable to have separate agreements with each trader, so the simpler consent procedure allowed for in the Act has been followed.

PRODUCTION OF HARDWARE REPORT

THE section of the report on the Census of Production for 1954 covering hardware, hollow-ware, metal furniture and sheet metal (Volume 5, Industry E) was published recently, price 2s. 6d. Copies are available from H.M. Stationery Office, Kingsway, London, W.C.2 and branches.

Non-Ferrous Metals List

THE Union des Industries de Metaux non Ferreux recently published the 2nd edition of the list of affiliated firms. It contains about 250 pages and has been edited in five languages, including English.

The list includes information on the Belgian non-ferrous metals industry ; alphabetical list of the 180 members, with their principal products ; and a catalogue of goods made in most forms of the principal non-ferrous metals.

The list costs 172 Belgian Francs and can be obtained from the Union, at 7, rue Joseph II, Brussels.

F.B.I. PAVILION FOR BRITAIN?

THE British Industry Pavilion at the Brussels Exhibition, described as a masterpiece of modern structural engineering, is to be disposed of by George Cohen Sons and Co. Ltd.

The main pavilion is completely walled with mirror-plate glass. It has a floor area of 60,000 sq. ft., entirely unobstructed except for the six main stanchions supporting the whole structure.

It is understood that Holland and Belgium are interested in retaining the pavilion but it is hoped that, like the Crystal Palace in its day, the building can be re-erected at some worthy site in Britain, perhaps to serve the future interests of industry.

MEETINGS OF THE MONTH

October 15

Institution of Production Engineers (London Graduate Section). " The Development and Applications of P.T.F.E. " by E. M. Elliott, A.M.I.E.E., A.M.I.Prod.E., at 10, Chesterfield Street, London, W.1. 7.15 p.m.

October 20

Institute of Metal Finishing (London Branch). " Recent Developments in Hard Anodizing," by F. Perkins, at the Northampton Polytechnic, St. Johns Street, E.C.1. 6.15 p.m.

October 22

Society of Chemical Industry. " Cavitation Damage ", by D. J. Godfrey, at 14 Belgrave Square, London, S.W.1. 6.30 p.m.

October 23

Institution of Production Engineers (London Branch). " Alloy Steels " (History, Manufacture and Applications), by R. E. Linton, at The Royal Empire Society, Northumberland Avenue, London, W.C.2. 7.0 p.m.

October 31

Institute of Metal Finishing (Sheffield and North East Branch) " Recent Developments in Polishing Techniques ", by J. H. Bryan, at the Grand Hotel, Sheffield. 7.0 p.m.

Birmingham Paint, Varnish and Lacquer Club, Joint meeting with Bristol O.C.C.A. at Bristol.

November 3

Plastics Institute, Midlands Section. " P.V.C. Coated Metals ", by W. E. Martin, B.Sc., at Grand Hotel, Leicester. 6.45 p.m.

November 4

Institute of Metal Finishing, Midland Branch. " Bright Acid Copper Plating ", by K. Roberts and P. Best, at the James Watt Institute, Great Charles Street, Birmingham. 6.30 p.m.

November 6

Birmingham Paint, Varnish and Lacquer Club, " Recent Advances in Drying Oil Chemistry ", by Prof. Hilditch, C.B.E., D.Sc., F.R.I.C., F.R.S., at Imperial Hotel, Temple Street, Birmingham. 7.50 p.m.

TECHNICAL *and* INDUSTRIAL APPOINTMENTS

RECTIFIER FOR FRENCH WORKS

A 64,000 amp rectifier plant for the electrolytic coating of zinc to steel sheets is shortly to be installed in the Sollac steelworks in eastern France. The plant includes oil-less water-cooled selenium rectifiers controlled by transductors. Westinghouse Brake and Signal Co. Ltd., King's Cross, London, are the main contractors for the rectifier equipment that has been manufactured entirely in France by their associates — Compagnie des Freins et Signaux Westinghouse.

A further step forward in the application of the company's germanium rectifiers has been made with the commissioning of a 23,000 amp rectifier installation at the works of the Glamorgan Acid and Alkali Co.

The equipment is used for the electrolysis of brine to produce chlorine employed in the manufacture of high-grade gelatine.

With an ultimate capacity of 3 megawatts, the rectifier is water cooled, the cooling circuit being electrically insulated from the d.c. circuit, thereby eliminating the problems which might otherwise result from leakage currents arising from low insulation resistance.

Water cooling ensures that the operating temperature of the germanium diodes is well within the safe limit and is based on a principle backed by the experience of over a million amperes of rectified current ; furthermore, the even temperature of the banks of germanium diodes aids even distribution of current among them, so very little derating of the diodes is required to avoid overloading those which have particularly good characteristics. Westinghouse have several orders in hand for germanium rectifiers for this and allied duties.

Zinc Productions

TOTAL refined zinc production for O.E.E.C. producer countries amounted to 67,705 metric tons in in June 1958, a drop over the previous month of about 3,000 metric tons, but compared with June 1957, there is no change in the level of production.

Mr. W. L. Baker, manager of the metal finishing division of **The Pyrene Co. Ltd.,** has retired after 30 years' service with the company. He has been succeeded by Mr. H. A. Holden, M.Sc., A.R.C.S., D.I.C., A.I.M., who has had many years' experience in the division. Mr. H. F. Parshall, M.A., T.D., who has been with the company for some 20 years, continues as director in charge of the division.

* * *

Mr. C. E. Holmstrom has retired from the position of joint managing director of **Firth-Vickers Stainless Steels Ltd.,** after 46 years' service with the company and its predecessors, and has been appointed a non-executive director of the company.

Following Mr. Holmstrom's retirement, Mr. J. T. W. Dewar, joint managing director of the company, has been appointed managing director.

* * *

Mr. Roy F. Belcher has been appointed publicity manager to **Desoutter Bros. Ltd.,** London, N.W.9., in place of Mr. Peter Allen who has now left the company. Prior to joining Desoutter, Mr. Belcher had spent three years in the publicity department of Decca Radar Ltd.

* * *

The Minnesota Mining and Manufacturing Co. Ltd. have appointed Mr. L. W. Smith sales supervisor for the south Midland region of the abrasives division.

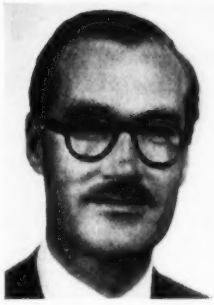
Mr. Smith joined the company in 1954 after having served with leading machine tool manufactures in this country. He succeeds Mr. Frank Mills, who has joined the 3M international division.

* * *

The **Ministry of Supply** announces that Major-General L. E. Cutforth, K.B.E., C.B. (Retd.), has been appointed director general of inspection in succession to Sir Thomas Barnard, C.B., O.B.E., who is retiring from the public service. General Cutforth took up his appointment on October 1.

* * *

The British Aluminium Co. Ltd. announce that Mr. P. T. Ensor, formerly general manager of the Canadian British Aluminium Co. Ltd., has now returned to the U.K. and has been appointed assistant to the commercial director, Mr. G. W. Lacey.



Mr. H. A. Holden

British Titan Products Company Ltd. have announced the appointments of Mr. N. D. Harris, Dr. P. A. Lintern and Mr. S. G. Tinsley as directors of the company.

Dr. Lintern and Mr. Tinsley have been with the company for many years. Mr. Harris was formerly chairman of I.C.I. (India) Ltd.

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Mr. R. J. Ledwith, who is chief chemist of **Cellon Ltd.,** has been appointed to the board of directors. He has been chief chemist for 15 years and has been 31 years with the company.

* * *

George Kent Ltd. announced the appointment recently of a new director, Mr. T. P. W. Norris, lately chief personnel officer of the Vickers Group, previously labour manager of I.C.I. Billingham Division and a former president of the Institute of Personnel Management. Mr. Norris has been appointed as deputy chairman.

Mr. R. E. Handford, B.Sc., deputy managing director, after 45 years in the company's service and 25 as a director, has relinquished his executive functions and retains his seat on the board. Mr. W. A. Hartop, who joined the company in 1927 and was appointed to the board in 1943, has been appointed as managing director : Commander P. W. Kent formerly chairman and managing director remains as chairman.

Two other directors have retired : Mr. W. Guy Ardley, a honorary member of the Institute of Water Engineers, joint managing director from 1938 - 1956 ; and Mr. Leslie H. Kent, A.M.I.C.E., M.I.Mech.E., R.B.A.

CORROSION STUDIES IN U.S.

Expansion of A.S.T.M. Programme Announced

A SUMMARY of the final results of the programme for determining the corrosiveness of various atmospheric test sites, as measured by specimens of zinc and steel, was presented by Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys at the 61st American Society for Testing Materials Annual Meeting, held in Boston, Mass., recently. It was proposed that this study be expanded to include calibration of the test sites at Newark (N.J.), Columbus (Ohio), East Chicago (Ill.), and Freeport (Texas).

The 60 specimens each of 74 commercially produced non-ferrous metals and alloys are being placed at four test sites throughout the United States. The specimens have been weighed, measured and analyzed for chemical composition. When withdrawn following exposure the specimens will be measured to determine loss in weight and depth of pits. The specimens will then be cut into tension specimens to determine loss of strength.

The second progress report on measurement of atmospheric factors of corrosion of metals was also presented. The data from this programme is being analyzed to see if there is any correlation between the rate of corrosion and the factors of time-of-wetness, SO_2 concentration, and temperature.

Corrosion Resistant Steels

Two subcommittees of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, are working on the development of a specification for thin stainless steel sheets of 0.006 to 0.010 in. thickness, used primarily in aircraft. A test procedure will be established to accumulate data for spec fication limits.

Maximum carbon limits in low-carbon grades of stainless steel are being studied in detail. The object is to satisfy the producers from the standpoint of reasonable production procedures and to meet the demands of the chemical industry for corrosion resistance and the high-temperature interests for elevated temperature properties.

Progress is being made toward ASTM specifications for high-temperature super strength alloys. Agreement has been reached that the alloys can be divided into four classifications : iron-base, cobalt-base nickel-base, and stainless steel (precipitation hardening). There are good prospects of a specification being ready by next year.

Magnetic testing methods for weight of zinc coat.

A preliminary report on the investigation of magnetic testing methods was presented at the meeting of Committee A-5 on Corrosion of Iron and Steel. In this programme, approximately 5,000 magnetic flux measurements have been made by 15 individuals using 11 instruments of 4 different types on 15 sets of specimens of commercial hot-dip galvanized sheet varying in thickness from 0.36 to 1.64 oz. per sq. ft. on the side tested. The general conclusion is that these instruments are satisfactory for the purpose and a detailed report on this study is being prepared for publication.

Polythene Powder Coatings

(*Continued from page* 405).

to achieve this " working," use is made of the principle known as fluidisation.

To fluidize the powder, it is carried on a bed of porous ceramic tiles or closely woven fabric raised above the bottom of the tank. Air is fed in from below and its diffused flow through the porous bed lifts the powder, so that it appears to be simmering. When the powder has risen to about one-and-a-half times its original height, articles placed on its surface sink immediately. A heated article passed gently through the powder will receive an even coating, even in sharp corners and crevices, without further agitation.

An air-pressure in the tank of less than 1-lb. per sq. in. and a rate of flow of 1½-2½ cu. ft. per sq. ft. of bed area (i.e., a linear flow of 1½-2½ft.) per min. will produce satisfactory fluidization, a process that is the subject of U.K. Patents Nos. 643,691 and 759,214 and of U.K. Patent Application No. 18709/56.

Treatment after dipping depends on the heat capacity of the metal. A large casting, for example, will retain sufficient residual heat to fuze the polythene layer into a smooth coating. On wire work and other light-weight articles, reheating is necessary to fuze the powder coating. In the elementary form of the process, the article is merely replaced in the oven till fusion is seen to be complete. A somewhat lower temperature, say about 150° C., is suitable for this operation. A second dip may be given at this stage if a thicker coating is required.

Cold-spraying Small Items

Cold spraying of polythene powder is particularly suitable for coating inside small vessels with comparatively small apertures.

The article to be coated is first heated in an oven or by flame to a temperature of 200°C.-260°C. The polythene powder is then blown through a nozzle onto the heated article. Spraying is continued until no further powder adheres, care being taken to cover the whole surface as quickly as possible to secure an even coat. The amount of powder taken up by the article will decrease as its temperature falls. The polythene is fuzed either by replacing the article in the oven or by passing a reducing gas flame gently to and fro over the semi-fuzed powder.

Flame spraying can be carried out by a specially-designed gun, on the oxy-coal-gas principle, first used to heat the surface to be coated to a temperature of 200°C.-250°C. Polythene powder from a vibrated container is then blown through the flame by compressed air, melted in its passage through the hot zone, and directed on to the heated article, to which it adheres. The hot metal completes the coalescence of the particles to form a continuous film. A large area can be covered by this method, using successive passes as in paint spraying, the whole operation being kept as continuous as possible to avoid reheating areas already coated.

High-Density Material

In addition to the so-called "normal " or " conventional " polythenes, high-density polythene is now available in powder form. Its anti-corrosive properties are in most respects similar to those of the familiar low-density material, but it is tougher and more rigid. It is also more difficult to give it a finish comparable visually with that given by conventional material, so that its use will be where decorative virtues are of less importance than its superior physical and mechanical properties.

TECHNICAL BOOKSHELF

Paint Finishing in Industry. A. A. B. Harvey. Robert Draper Ltd., 85, Udney Park Road, Teddington, Middlesex. 516 pp. 4 gns.

IT is not a very long time since the variety of paints available was so small and the methods by which they could be applied were so few that paint application, although certainly not without its technical difficulties would hardly have merited discussion and illustration to the extent of a 500 page book. There are still active today master decorators reared in the old craft of grinding their own colours and knocking up their own paints in accordance with a long established lore, and such as these still tend to regard the modern ready-made paint with much the same sort of aversion as Mrs. Beeton might be expected to greet dehydrated chicken noodle soup. However, modern methods of production in the factory, even as in the kitchen, are moving at an ever accelerating tempo and demand not only high rates of output but complete consistency in materials and processes.

When carriages or indeed motor cars were produced at high cost for a restricted market, the fact that the finish was applied by brush in several coats with many days drying time between each coat, was of small significance, but obviously such methods cannot be used on components produced at rates up to thousands a day. Hence there has arisen a wide variety of new paint formulations adapted to the growing range of methods of applications and designed to meet evermore exacting service requirements.

As might be expected this extensive development in the paint finishing industry has been accompanied by a considerable increase in the volume of published work on the subject. The author of the book here reviewed, is well known, both for his writings on the subject and for his many contributions to its technical discussion. The fact that the greater part of his experience has been with the automobile industry has not been without its influence on his general approach to the subject, although the fact that illustrations in particular of the finishing of car body parts greatly preponderate in number, may only be a reflection of the fact that it is in the automobile industry that paint finishing as a mass production process has been brought to its highest peak of perfection.

The book performs a valuable function in bringing together information on pretreatment, application and stoving by all methods currently in use, and although not attempting to provide an authoritative treatise on paints themselves it does provide a useful survey of the general types of finishing materials which are available and their individual properties, advantages and disadvantages. The chapter on Paint Testing is comprehensive, although it is doubtful whether more than the most specialized laboratory would be equipped, or even interested, in carrying out more than a fraction of the tests discussed. Wood finishing is also considered in one chapter and the book can be recommended as a useful survey.

Sales Campaign for V.E.

(*Continued from page* 404)

what might be called poor imitations of our product." The public had often been, and still was to a limited extent, misled into believing that a product finished in "enamel" is vitreous, when in actual fact it was nothing of the sort.

He said that in conjunction with other associations in the industry, standards of quality had been established with the national gas boards and others, and shortly the British Standards Institution was to issue a specification covering vitreous enamel finish.

Speaking of the advisory service he said that one of its functions was to bring together the designer, enameller and purchaser.

Of the future, he thought it could be said that British made enamels were still amongst the best produced in the world and that progress in development of new and better forms to meet the wider demands of industry was going on in the U.K. at as great a rate as anywhere in the world.

Also on the platform with Mr. Parker were Dr. B. K. Niklewski (R. and A. Main Ltd.) and Mr. J. Semple (Metal Porcelains Ltd.).

Compressor in the Antarctic

(*Continued from page* 406)

was present during the erection of the buildings at the base.

The main function of the compressor was to supply air for the removal of cuttings while drilling holes five to twenty ft. in diameter with a portable rotary diamond drill.

After the hole had been drilled, a ¾-in. rod with a nut on the lower end was lowered into the hole which was then filled with water and allowed to freeze. These anchor rods were used to secure buildings and radio masts and more than three hundred were drilled. In addition, air was used for percussion drills and spades.

The compressor operated well into the second winter at the base without a "worry," and the only modification required was a canvas cover to close off the cooler during the warm-up period.

The report goes on to state that oil recommended and supplied by B.P. was used throughout the 500 hr. of operation, and the compressor was in first-class order when the job was completed.

NEW COMPANIES

"Ltd" is understood, also "Private Co."
Figures = Capital, Names = Directors, all unless otherwise indicated.

Morton Paints, 6a Bannerman Road, Kirkby-in-Ashfield, Notts. August 14. £10,000. Charles H. Morton, Ernest Morton.

C. A. & G. Forster & Sons, Armada Works, Wellington Street, Sheffield, 1. August 28. £1,000. To carry on bus. of electro, chromium, nickel and metal platers, polishers and finishers, etc. Charles A. Forster and Grace Forster.

Donald Miller (Stovit), Spring Street Garage, Brighouse. August 29. £1,000. To carry on bus. of shot-blasters, stove enamellers, spray painters, cellulosers, etc. Donald Miller and Mrs. Mary Miller.

S. Hall (Filler), 19/20 Holborn Viaduct, E.C.1. September 4. £1,000. To carry on bus. of manufacturers of and dealers in plastic and synthetic materials used in connexion with the repair of motor bodies, etc. Siegfried Hall, Fritz Gilster.

From the Register compiled by Jordan & Sons Ltd, 16, Chancery Lane, London, W.C.2.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Sawing Machine and Grinder

THE "Ulmia" 1570 circular sawing machine is claimed to be an advance on the standard type of hand lever machine because of its higher power as well as the accurate and burr free finish that can be obtained. A further innovation claimed for this type of saw is that the stock head together with the saw blade can be turned to a range of 50 deg. either side. The large cutting range is indicated by the following: 1½-in. m.s. bar is cut in 32 sec., 2-in. tube in 8 sec., 3-in. angle in 12 sec.

The KS 5 economy grinder illustrated in Fig. 1 is made by Scheer. The makers say that the resilient plastic grinding wheels on the high-speed angle grinder can be used throughout the entire diameter of the wheel, so that the discarding of run down wheels is virtually eliminated. In addition, the tool has no parts subject to wear since the grinding wheel is directly clamped on the motor shaft. Further advantages claimed are light weight, excellent handling, and an unobstructed view of the grinding wheel.

An easily operated push-button switch in the handle has a locking button. A rubber handle can be screwed to either side of the tool at a right angle to the main handle. Brief technical details are: universal motor for D.C. and A.C. current supply with a built in speed controller; input 1,000 W.; idling speed 13,300 r.p.m. max. wheel dia 4½ in.; max. peripheral speed 262 ft. per sec.

Both tools can be supplied in the U.K. by the Addison Tool Co. Ltd., 10 Old Street, London, E.C.1.

Fig. 1.—Grinder with a resilient plastic wheel

French Ultrasonic Cleaning Plant

FOR a number of years, ultrasonic cleaning equipment manufactured by Realisations Ultrasoniques has been used on an extensive scale by engineering establishments in France. The equipment is now available in the U.K. from J. Millar, Ultrasonic Applications, Ltd., 32 Finsbury Square, London, E.C.2.

Advantages claimed for the "Cleansonic" process, as it is called, are that it gives perfect cleaning with a lower power consumption, and this is achieved with both a labour and time saving factor. It is, of course, a cold cleaning process, and is suitable for both continuous operation or for use in cleaning individual objects. It will operate with any solvent.

In use, the workpieces are placed in a holder which is then immersed in the processing tank already filled with solvent. The principle of operation is similar to other types of ultrasonic cleaning equipment; a supersonic field of high intensity produces in the tank a powerful cavitation effect that results in a perfect cleaning of the immersed workpiece in a few fractions of a second.

The size of equipment available covers a wide range with tanks of various shapes and sizes. Additional equipment such as filtering, cooling and drying units, and protecting baths are also available if required.

The firm also makes many other pieces of equipment including automatic cleaning machines having a continuously or discontinuously moving chain to which workpieces can be attached for various treatments. Installations for cleaning, oil-removing and pickling are also available, and in addition, there is a range of fault-detecting apparatus that uses both the "echo" and "transparency" methods of ultrasonic testing. Another instrument uses the "resonance" method. Ultrasonic apparatus for controlling automatic processing machinery is also made by the company.

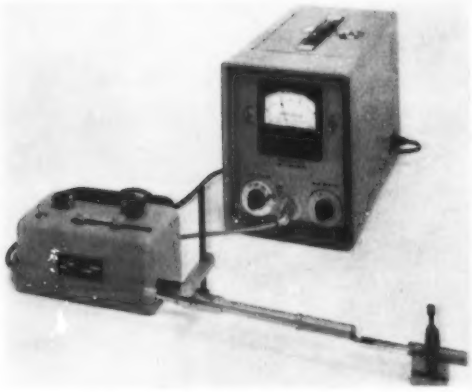

Fig. 2.—Micrometrical " package " unit

Improved Surface Roughness Instruments

THREE new items of equipment recently introduced by the Micrometrical Manufacturing Co., 345 South Main Street, Ann Arbor, Mich., U.S.A., and shown for the first time at one of the large American technical exhibitions held this year, are a Type QC " Amplimeter," a type LK Tracer, and a Group III Package. The tracer is particularly interesting since its use makes possible the checking of internal diameters as little as $\frac{1}{8}$ in. The instruments are used to provide roughness measurements of surfaces.

Type QC " Amplimeter." The instrument differs from previously introduced equipment in that it provides for cutoff and scale selection in one unit. Used with the Type V " Mototrace," it provides cutoff selection of 0.010, 0.030 and 0.1 in. roughness width, with a tracing speed of 0.3 in. per sec. The instrument is plugged into a 115-V. supply. It will read r.m.s. or arithmetical average roughness height, as selected by a panel-mounted switch. Its accuracy can be quickly checked by comparison with a standard test piece. Operation of the on-off switch illuminates the measuring dial. The instrument amplifier is unaffected by voltage fluctuations between 90 and 130 V., neither is it sensitive to mechanical shock or vibration. In addition to a plug-in receptacle to provide current to the tracer, there is a power outlet for a " Mototrace," or a motor driven piloter, etc. A plug-in jack is also provided for a reading recorder or other external meter. Size is 8-in. wide x 15-in. f. to b. and it can be used with all existing Profilometer equipment.

The Type LK Tracer is able to measure surface roughness on i.d.'s of as little as $\frac{1}{8}$ in. to a depth of $\frac{11}{16}$ in., in addition to other surfaces such as flats, tapers, narrow splines, and gear teeth. It can be operated either by a " Mototrace " or by hand. The wide range of versatility is obtained by using one of three interchangeable skidmounts, attached to the instrument by an adaptor.

The Profilometer Group III Package comprises the QC " Amplimeter " and the LK tracer together with a Type V " Mototrace " (Fig. 2). The " Mototrace " imparts a smooth, steady tracing motion, at a speed of 0.3 in. per sec., with quick reversals, over any desired length of trace from $\frac{1}{16}$ in. to $2\frac{3}{4}$ in. A linkarm attaching the " Mototrace " to the tracer has swivelling points that allow the tracer to follow contours and tapers.

English agents for this equipment are Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11.

Low Cost Platinum Plating

LOW-COST in platinum plating, for high temperature and other exacting industrial applications, is claimed for " Platinex III/LS " by the precious metals division of the Sel-Rex Corpn., Nutley, N.J., U.S.A. The company says that Platinex produces a pore-free platinum electroplate, in any practical thickness, directly from the bath in one continuous operation.

In conventional platinum plating, the work must be removed from the bath at frequent intervals for burnishing or scratch brushing to produce a commercially acceptable electroplate. The elimination of this costly repetitive operation has made platinum plating economical enough to use for a wide range of industrial applications.

Platinex III LS produces a fine-grained grey-coloured electroplate that duplicates exactly the surface of the basis metal. It is said to offer far greater corrosion resistance in high temperature ranges than even rhodium plate, being able to withstand over 2000°F. indefinitely, with absolutely no evidence of oxidation. According to laboratory reports, the low stress and high ductility features of the process are so pronounced that electroformed sheets can be formed or even crimped without cracking.

According to descriptive literature produced by the company, the bath requires only the addition of a replenisher and water for maintenance, and operates at a relatively cool 75° to 85°C. Sel-Rex state that this lower operating temperature plus their exclusive formula makes the Platinex bath exceptionally long-lived, as well as eliminating the noxious fumes encountered in current platinum plating operations.

Anticipated applications include high temperature connectors and circuitry for missile manufacturing, and silicon and germanium transistors.

Agents in the U.K. for Sel-Rex are M.L. Alkan Ltd., Stonefield Way, South Ruislip, Mddx.

(*Continued in page* 414)

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Laboratory-size Ultrasonic Process Machines

THE new Series 200 Narda " Sonblasters," a mass-produced laboratory-size ultrasonic cleaning and chemical process investigation unit (Fig. 3), has just been introduced by the Narda Ultrasonics Corporation, Mineola, L. I., New York, U.S.A. The series consists of four systems adapted to a wide range of laboratory and industrial operations, and has been designed for economy in cleaning small precision made parts and subassemblies, or laboratory glassware and apparatus. The makers say that the equipment is ideally suited for emulsifying, plating, brightening, etching, impregnating and many other laboratory applications.

The Series 200 Sonblaster equipment consists of an ultrasonic generator, Model G-201 or G-202, and stainless steel transducerized tanks, NT-201 or NT-202, of $\frac{1}{8}$ and $\frac{3}{4}$ gal. capacity, respectively.

The Model G-201 Sonblaster generator uses 115-V., 60 c.p.s. input power and is fused for 2 amp. The ultrasonic power output to the transducer is 35-W. average, and 140-W. pulse at 90 kc. Cabinet dimensions are $7\frac{1}{2}$ in. high x $8\frac{7}{8}$ in. wide x $8\frac{1}{4}$ in. deep. Weight is 10 lb. The generator panel includes an on-off switch, activity control knob, fuse holder, and panel light. The model G-202 Sonblaster is identical to the G-201, except that it is available with a choice of four duty cycle timers ; 15 min., 30 min., one hr., and two hrs.

The Sonblasters are fully portable, and can be plugged into any convenient 115-V. AC outlet.

Operation is simple ; once the tank has been filled with the desired chemical or cleaning solution, the switch is operated and processing begins.

English agent for Narda is Col. J. D. Parker, Aveley Electric Ltd., Ayron Road, Aveley Industrial Estate, S. Ockenden, Essex.

Adhesive Coating Allows Time Lapse

A RECENTLY perfected adhesive being marketed by Evode Ltd., Common Road, Stafford, allows a time lapse between applying the adhesive and using the coated component.

A typical example is in the bonding of P.V.C. material to metal. An adhesive film of uniform thickness is applied to both the P.V.C. and the metal by a roller or a doctor blade, and the film is then dried off by air-draught. The dried components can then either be used immediately, or left for any period up to seven days.

When these precoated components are to be used they are reactivated by infra-red rays at a temperature of about 85° C. When the resins in the adhesive become tacky, treated surfaces of the P.V.C. and metal are pressed into contact. The makers say that the bond obtained by this method is usually far stronger than that previously obtained by using conventional binding techniques.

Fig. 3.—Ultrasonic cleaning unit

The new technique has already made possible the bonding of thin sheet P.V.C. to metal in one continuous process, while in another sphere multilaminations of fibre board and metal can be constructed by machine process with a great saving of labour costs. As the Evo-Stik high reactivation process (as the method is called) becomes better known it is expected that it will be adopted for many mass production applications in which adhesives play a part.

Acrylic Stoving Finish

'DULUX' acrylic stoving enamel F 664-line — a new one-coat paint finish for domestic equipment — has been introduced recently by I.C.I. Paints Division. The material, whose properties are derived from the new acrylic resins on which it is based, is particularly suitable for refrigerators, washing machines and other metal equipment used in kitchens and bathrooms. The makers claim it has a number of advantages over the usual two-coat system of primer and finish, and they say its resistance to yellowing and staining in kitchens is better and it has higher gloss and build.

I.C.I. says that in appearance and other properties 'Dulux' acrylic stoving enamel is " midway between vitreous enamel and an ordinary paint finish," that there are undoubtedly applications where it can be considered as an alternative to vitreous enamel and that satisfactory tests have already been carried out on washing machine tops.

No primer coat is normally necessary and a stoving operation is thus saved. In a one-coat system with a film thickness of about 0.00175 in. it is claimed to give a superior performance to that of any established two-coat system.

'Dulux' F 664-line can be used on steel, electrolytically zinc-coated steel and aluminium, provided these are suitably pretreated. A chemically clean and corrosion-free surface is essential before painting. Dipping or stoving primers can be supplied for covering surface imperfections.